Australasian Plant Conservation

Bulletin of the Australian Network for Plant Conservation Inc

Volume 25 Number 4 March – May 2017

Special theme: 'New approaches to plant conservation challenges in the modern world' – Part 2

Papers from the 11th Australasian Plant Conservation Conference, Melbourne, 14-18 November 2016

ANPC INC. MISSION STATEMENT: To promote and improve plant conservation

ANPC National Office

GPO Box 1777
Canberra, ACT 2601, Australia

T (02) 6250 9509 | **F** (02) 6250 9599
E anpc@anpc.asn.au
W www.anpc.asn.au

National Office Staff

Martin Driver, Jo Lynch, Carly Westbye

ANPC Committee

President Linda Broadhurst
Vice President Bob Makinson
Treasurer Merryl Bradley
Secretary Melissa Millar

Committee Members

Doug Bickerton, Kate Brown, Anne Cochrane, David Coates, Chantelle Doyle, Paul Gibson-Roy, Michelle Haby, Maria Matthes, Cathy Offord, Natalie Tapson

ANPC News

Go to www.anpc.asn.au/news to read the latest newsletters and subscribe.

New Zealand Plant Conservation Network

President Sarah Beadel
Secretary Rewi Elliot

PO Box 2199, Wellington, New Zealand

E info@nzpcn.org.nz
W www.nzpcn.org.nz

Front cover: Attendees on the APCC11 Conference Field Trip to Wilsons Promontory National Park standing around an enclosure which shows the resulting grass regeneration when grazing animals are excluded. Photo: Geoff Robertson

Printed by: Trendsetting, Canberra.

Australasian Plant Conservation

Editor
Paul Adam

Editorial Team
Paul Adam, Doug Bickerton, Michelle Haby, Jo Lynch, Cathy Offord and Carly Westbye

Layout & Graphic Design
Siobhan Duffy

Australasian Plant Conservation is produced by the ANPC Inc. with assistance from the Australian National Botanic Gardens.

Australasian Plant Conservation is printed on recycled paper.

ISSN 1039–6500

Copyright
Opinions expressed in this publication are those of the authors and are not necessarily those of the ANPC or its sponsors. Material presented in *Australasian Plant Conservation* may be copied for personal use or published for educational purposes, provided that any extracts are fully acknowledged. Where any material is credited to and/or copyright to another source, please contact the original source for permission to reprint.

Contributing to *Australasian Plant Conservation*

Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research, and diary dates are welcome. General articles on any plant conservation issue are most welcome.

The deadline for the September – November 2017 issue is 23 June 2017. The special theme for the issue is *Provenance*. If you are intending to submit an article or wish to discuss possibilities, please email the editor, Paul Adam: editor@anpc.asn.au

Authors are encouraged to submit images with articles or information. Please submit images in electronic format, resolution needs to be at least 300 dpi, at least the size that they are to be published, in tif, jpg or gif format. Guidelines for authors and an article template are at: http://www.anpc.asn.au/apc.

Using the article template, please send articles, no more than 1200 words, as an MS Word file by email to: editor@anpc.asn.au.

ANPC Major Sponsors

GOLD SPONSORS

AUSTRALIAN NATIONAL BOTANIC GARDENS

OTHER SPONSORS

Threatened Species Recovery Hub
National Environmental Science Programme

NSW GOVERNMENT | NSW Environmental TRUST

ROYAL BOTANIC GARDENS VICTORIA

NSW GOVERNMENT | Local Land Services

LA TROBE UNIVERSITY

RURAL INDUSTRIES Research & Development Corporation

THE NORMAN WETTENHALL FOUNDATION

ECOLOGY AUSTRALIA

EUCALYPT AUSTRALIA

Australian Plants Society Maroondah Group

This issue

From the editor *by Paul Adam* 2

New approaches to fighting native plant extinction *by Gregory Andrews* 3

Restore & Renew, a wealth of new information in support of ecological restoration practices *by Maurizio Rossetto* 5

Climate-ready revegetation. A guide for natural resource managers *by Nola Hancock, Rebecca Harris, Linda Broadhurst and Lesley Hughes* 7

Genetic rescue of the Plains Yam Daisy (*Microseris scapigera*) on the Merri Creek *by Brian Bainbridge* 9

Managing imperfection in post-mined landscapes: determining the best practicable ecosystem reference sites *by Nic McCaffrey, Peter Erskine and David Doley* 12

The devolved grant model: Achieving lasting conservation outcomes across Tasmania *by Peter Stronach* 14

Engineered co-existence of novel green roof habitat holds conservation promise *by Pamela J.A. Spencer* 17

Friends of the Royal Tasmanian Botanic Gardens Grant Recipient Report 2016 – Attending the 11th Australasian Plant Conservation Conference (APCC11) *by Lorraine Perrins* 19

Report on APCC11 Conference Field Trip to Wilsons Promontory National Park *by Geoff Robertson* 22

Regular features

News from the Australian Seedbank Partnership 23

ANPC Member Profile 24

ANPC Workshop Reports 26

News 28

Research Roundup 30

ANPC Corporate Members 33

The production of this edition of *Australasian Plant Conservation* was supported by the **NSW Environmental Trust** through its Lead Environmental Community Groups program.

NSW GOVERNMENT

NSW Environmental TRUST

From the editor

PAUL ADAM

This issue is the second containing articles based on presentations at the successful 2016 Melbourne conference. We were privileged at the conference in having the opening address presented by the Commonwealth Threatened Species Commissioner, Gregory Andrews, so it is a pleasure that this issue commences with a summary of his talk and the full list of the thirty plant species that are priorities for action over the next few years to save from extinction. (This is not to say that the many other threatened species will be ignored or neglected, but the flagship species will certainly raise public interest and concern for threatened plant species more generally and, it is to be hoped, this will translate into more action and further conservation actions.)

The other articles admirably demonstrate the diversity of approaches to new conservation challenges and opportunities. Having enjoyed a mining boom, Australia is faced with the long term challenge of rehabilitating what is in total a vast area of land, spread across the diverse environmental conditions of a continent. Nic McCaffrey and colleagues describe how industry is addressing the problems.

With the rapid increase in urbanisation in many parts of the world, there is global interest in the need to promote conservation in urban areas – with advantages both for the species concerned and through connecting humans with nature. Pamela Spencer points to exciting possibilities of developing wildlife habitats on the roofs of city buildings.

Maurizio Rosetto shows that obtaining the necessary data for modern conservation approaches can be achieved efficiently and relatively inexpensively – and provide opportunities for challenging fieldwork! Brian Bainbridge shows how volunteers can collect population data systematically over time – a great example of citizen science in action. Peter Stronach describes a Tasmanian initiative for providing funding for on-site conservation, an approach worthy of consideration elsewhere.

Although the ANPC makes extensive use of volunteers and actively seeks sponsorship to assist in keeping costs down, there is no doubt that in this time of budget stringency and, given the tyranny of distance which often translates to high travel costs, attendance at conferences is a challenge for many potential participants. It is therefore a particular pleasure to be able to reproduce Lorraine Perrins' report to the Friends of the Royal Botanic Gardens Hobart. Firstly it demonstrates the benefits that can be gained through participation in conferences, but also it provides a further opportunity to extend thanks to the Friends for providing funding which enabled Lorraine to attend.

The issue also contains regular items – News from the Seed Bank Partnership, a workshop report from the latest of our Project Manager's field events in inland NSW (and in a summer of extreme weather in much of eastern Australia, admiration is due both to Martin and the workshop participants for their fortitude), News, and the always informative Research Roundup.

The ANPC gratefully acknowledges the support of all our APCC11 sponsors, and in particular the following major sponsors:

ROYAL BOTANIC GARDENS VICTORIA
LA TROBE UNIVERSITY
ECOLOGY AUSTRALIA
EUCALYPT AUSTRALIA
RURAL INDUSTRIES Research & Development Corporation

New approaches to fighting native plant extinction

GREGORY ANDREWS
Australia’s Threatened Species Commissioner
Email: ThreatenedSpeciesCommissioner@environment.gov.au

Last November, I was honoured to be the keynote speaker at the 11th Australasian Plant Conservation Conference in Melbourne. It was a wonderful opportunity to engage with some of Australia’s leading botanists and conservationists and share ideas on preserving our incredible native plants. Protecting Australia’s endangered plants and vegetation communities is one of my highest priorities. In my address, I spoke about the Australian Government’s commitment and the innovative approaches being used to protect some of our most vulnerable flora species from extinction.

In 2015, the Australian Government launched our first Threatened Species Strategy, based on science, action and partnership. The Strategy has been backed by over $211 million and provides a set of prioritisation principles that guide the work we do. It includes targets to improve trajectories of 30 targeted threatened plant species (see Table 1), and to insure all known threatened plants against extinction by 2020.

Gregory Andrews with Dr Ashley Field viewing the habitat of the critically endangered Mossman fairy orchid (*Oberonia attenuata*). Photo: The Office of the Threatened Species Commissioner.

Table 1. Australia’s Threatened Species Strategy commits to improving the trajectories of these 30 threatened plants by 2020. More information including a factsheet is available at: http://www.environment.gov.au/biodiversity/threatened/species/30-plants-by-2020.

Common Name	Scientific Name
Ant Plant	*Myrmecodia beccarii*
Black grevillea	*Grevillea calliantha*
Blue-top sun-orchid	*Thelymitra cyanapicata*
Bulberin macadamia nut	*Macadamia jansenii*
Button wrinklewort	*Rutidosis leptorrhynchoides*
Caley's grevillea	*Grevillea caleyi*
Central Australian cabbage palm	*Livistona mariae*
Fairy bells	*Homoranthus darwinioides*
Fitzgerald’s mulla-mulla	*Ptilotus fasciculatus*
Fleurieu leek orchid	*Prasophyllum murfetii*
Glossy-leaved hammer orchid	*Drakaea elastica*
Kakadu hibiscus	*Hibiscus brennanii*
Little mountain palm	*Lepidorrhachis mooreana*
Magenta lilly pilly	*Syzygium paniculatum*
Matchstick banksia	*Banksia cuneata*
Mongarlowe mallee	*Eucalyptus recurva*
Morrisby's gum	*Eucalyptus morrisbyi*
Mossman fairy orchid	*Oberonia attenuata*
Ormeau bottle tree	*Brachychiton* sp. Ormeau
Purple wattle	*Acacia purpureopetala*
Scaly-leaved featherflower	*Verticordia spicata* subsp. *squamosa*
Shy susan	*Tetratheca gunnii*
Silver daisy-bush	*Olearia pannosa* subsp. *pannosa*
Silver gum	*Eucalyptus crenulata*
Small purple pea	*Swainsona recta*
Southport heath	*Epacris stuartii*
Spiny rice-flower	*Pimelea spinescens* subsp. *spinescens*
Turnip Copperburr	*Sclerolaena napiformis*
Vincentia banksia	*Banksia* sp.
Whibley's wattle	*Acacia whibleyana*

Caley's grevillea (*Grevillea caleyi*). Photo: Erin Lake.

Actions identified to save Australia's threatened plants include seed collection, seed banking, habitat protection and restoration, replanting wild populations and planting conservation collections off site, including in Australia's world class botanic gardens.

Our work has only just begun, but already some impressive results have been seen through community support and Australian Government initiatives such as the Green Army, 20 Million Trees and National Landcare Programmes, and the Australian Seed Bank Partnership. For example, one of our 30 targeted plant species, the Magenta lilly pilly (*Syzygium paniculatum*), will see its wild population increase by 33 per cent based on the work of just one 20 Million Trees project. Another, the Central Australian cabbage palm (*Livistona mariae*), has benefited from a $320,000 investment to improve the health of remote waterhole habitats and the work of Green Army teams collecting seeds to grow insurance populations.

While these results are encouraging, we continue to look for new and innovative approaches to leverage support for threatened species conservation.

In February the Minister for the Environment and Energy, the Hon Josh Frydenberg MP, launched the Threatened Species Prospectus. This public-private collaboration asks big business and philanthropic organisations to help tackle the fight against extinction. It includes projects to safeguard all 75 nationally threatened eucalypt species and to save Australia's only purple wattle.

Later this year, we will hold an open round for the Threatened Species Recovery Fund. Through this fund individuals and organisations can apply for up to $250,000 for projects that deliver on-ground benefits for threatened species listed under the Environment Protection and Biodiversity Conservation Act.

By working together and continuing to develop new approaches to fighting extinction we can help ensure the future of Australia's iconic plant species. To learn more about these initiatives and find out how you can get involved please visit: http://www.environment.gov.au/biodiversity/threatened/commissioner or my Threatened Species Commissioner social media channels Instagram, Twitter, Facebook and YouTube.

Restore & Renew, a wealth of new information in support of ecological restoration practices

MAURIZIO ROSSETTO

National Herbarium of NSW, Royal Botanic Gardens and Domain Trust, Sydney, NSW
Email: maurizio.rossetto@rbgsyd.nsw.gov.au

Evolutionary challenges in restoration

The Restore & Renew project at Sydney's Royal Botanic Gardens aims to equip restoration practitioners and land managers with easily accessible evolutionary, environmental and ecological information that has previously been missing from their tool kits. This ambitious project has the potential to save time and resources by increasing the chances that newly planted areas are genetically suitable and likely to flourish over time.

Restoration is a considerable global enterprise valued in the trillions of dollars, and revolving around international agreements that establish global targets and commitments (see the Bonn Challenge for example; http://www.bonnchallenge.org/content/challenge). The recent publication of the National Standards for the Practice of Ecological Restoration in Australia (McDonald *et al*. 2016), highlights the need for high quality restoration work.

The momentum behind the preservation and restoration of native vegetation, has resulted in considerable technical and theoretical advances (Falk *et al*. 2006). New insights on species selection, site preparation, planting techniques, community dynamics, ecological function and long-term monitoring (and much more of course) are emerging. The conferences and regular bulletins coordinated by the ANPC are a testimonial of how on-ground practices have evolved through the years.

One component of the restoration process that remains challenging is the decision of where to source plant or seed material. A deeper understanding of plant evolutionary patterns could vastly increase the success of restoration projects, especially in the context of a changing climate and increasing habitat fragmentation. Guidelines have been developed for collecting seed from local and / or mixed sources to account for the potential risks associated with outbreeding vs. inbreeding depression, within current vs. future climatic scenarios. Yet the information necessary for their implementation is rarely available, and unfortunately extrapolations from a wider analytical context down to local species can be hazardous (Broadhurst *et al*. 2017). For any target species, what are 'local' genetic and / or climatic boundaries, what are 'natural' levels of diversity and fitness, what future environmental shifts are expected?

Extreme sampling: collecting eucalypts from a cliff in the Blue Mountains. Photo: Maurizio Rossetto

Until recently obtaining the necessary evolutionary and environmental information was perceived as being too complex, time-consuming and costly to be justifiable across a large number of species. However new high-tech developments have come to the rescue, and researchers are no longer constrained by the availability of data, as large amounts of information can now be outsourced for multiple species cheaply and quickly (Rossetto and Henry 2014).

What is Restore & Renew?

Restore & Renew is sampling and studying over 200 plant species commonly used in landscape restoration.
The target species were selected after consultation with restoration practitioners, nurseries and other restoration ecologists across NSW to represent functional, geographic and ecological diversity (Hogbin and Rossetto 2014). Their genetic profiles, distribution and environmental requirements are being analysed, collated and mapped along with current and future climate models. The relevant information will be presented through a comprehensive, user-friendly website to inform recommendations for ideal seed sourcing and restoration strategies.

Sampling: for each species, we capture genetic profiles from multiple individuals collected across 30-50 representative (geographically and environmentally) populations. Collections are organised taxonomically and geographically, and we sample multiple species at each site to streamline the process and optimise our analyses. This enormous logistic undertaking (possibly the most complex component of the project) involves staff, students, collaborators and volunteers (and yes, additional help is always welcome!).

Analyses: the advent of automated, high throughput genomic technologies (one of the many outcomes of the Human Genome project), enables scientists to analyse thousands or millions of DNA sequences at the one time. Each plant has a unique DNA profile, and along with information on the biology of a species, this profile provides valuable information on current and historical factors that have shaped its distribution. We have developed analytical pipelines that summarise genomic and environmental data for each of the target species as soon as it is available. Special software determines the distribution of genetic variation across the landscape, estimates the levels of connectivity within and between populations, and defines local genetic and climatic boundaries.

Outreach: we are currently working with the Office of Environment and Heritage (OEH) to develop the public interface for Restore & Renew within BioNet (www.bionet.nsw.gov.au). From this website, restoration practitioners will be able to select their species of interest, identify where they want to restore it, and obtain relevant information on what material to source and where.
For each species at each selected site, alternative practical scenarios will be provided, showing how much diversity can be gathered by varying the numbers of source plants sampled, and the area from which these are sampled from. The information provided will be derived from available data on natural levels of connectivity between populations and on the distribution of similar habitat, and interpretative consideration will be included with each option.
The objective is to provide tailored answers for every location, for every species rather than generalisations.

When: although the project was to be officially launched in mid-2017, and the website will be accessible a little after that, we have already collected close to 8,000 plant samples representing 97 species from over 700 NSW sites. So far, a total of 16 species have been fully sequenced.

What else will Restore & Renew do?

The analytical processes and their implementation through the web-based portal will be updatable as new or different information becomes available. For example:

- Although the current focus is to provide information on how to maximise genetic diversity with ‘minimal effort’ from an area defined by current connectivity and environmental conditions, our sampling strategy enables us to specifically explore adaptive boundaries. Consequently, in a second stage we will also provide seed sourcing strategies based on adaptive scenarios that take into account predicted climate change.

Another strength of the project is in its uniform, multispecies sampling strategy. This means that as the number of species analysed increases additional data interpretations will be possible. For example:

- Repeated patterns across functional groups will enable us to provide more accurate generalisation for species that have not been analysed.
- Repeated patterns across the landscape will help us identify refugia, biogeographic barriers, centres of diversity and much more.
- Finally, although the current focus is NSW, we are eager to expand collaborations beyond State borders (after all species do not recognise geopolitical boundaries!).

Acknowledgements

I would like to acknowledge the whole Restore & Renew team, staff, students and volunteers. Funding for this project is provided by donors and sponsors, with a special thank you to HSBC and the NSW Environmental Trust (please contact us if interested in getting involved). Diversity Arrays Technology provide continuing technical and developmental support.

References

Broadhurst, L., Breed, M., Lowe, A., Bragg, J., Catullo, R., Coates, D., Encinas-Viso, F., Gellie, N., James, E., Krauss, S., Potts, B., Rossetto, M., Shepherd, M. and Byrne, M. (2017). Genetic diversity and structure of the Australian flora. *Diversity & Distributions* 23: 41-52.

Hogbin, T. and Rossetto, M. (2014). Restore and renew NSW: online survey of NSW restoration practitioners identifies species considered most useful in restoration. *Australasian Plant Conservation* 22(4): 26.

Falk, D. A., Palmer, M. A. and Zedler, J. B. (2006). *Foundations of restoration ecology*. Washington, DC: Island Press.

McDonald, T., Jonson, J. and Dixon, K.W. (2016). National standards for the practice of ecological restoration in Australia. *Restoration Ecology* 24(S1): S4–S32.

Rossetto, M. and Henry, R.J. (2014). Escape from the laboratory: new horizons for plant genetics. *Trends in Plant Science* 19: 554-555.

Climate-ready revegetation. A guide for natural resource managers

NOLA HANCOCK[1*], REBECCA HARRIS[2], LINDA BROADHURST[3] AND LESLEY HUGHES[1]

[1] Department of Biological Sciences, Macquarie University, [2]Antarctic Climate Ecosystems CRC, University of Tasmania, [3]CSIRO
*Email: nola.hancock@mq.edu.au

Introduction

Globally, 2016 was the hottest year on record, the third hottest year in a row (Steffan *et al.* 2017). At the current rate of emissions, the annual mean air temperature in Australia is projected to increase by 2.8 – 5.1°C (above the climate period of 1986-2005) by 2090 (CSIRO and Bureau of Meteorology 2015). Extreme weather events have already increased in frequency and in some cases, intensity, and this trend will continue e.g. extreme heat, bushfires, coral bleaching and storms (Steffan *et al.* 2017). These changes are already problematic for some species and populations, and planting lists for future revegetation activities need to consider the long-term sustainability of local plants. A new publication, *Climate-ready revegetation. A guide for natural resource managers*, provides step-by-step guidance on where to find and to how to use on-line tools to gauge if existing vegetation (species and local populations) are likely to be sustainable as the climate continues to change. A brief summary of the steps detailed in the Guide is provided below. The full version of the Guide and a downloadable pdf is available at: http://anpc.asn.au/resources/climate_ready_revegetation.

Finding climate projections at the regional level

The first step towards assessing the suitability of local species and populations for revegetation projects is to access climate projections at a downscaled spatial resolution. The www.climatechangeinaustralia.gov.au web site provides projections for eight regions within Australia. Some States offer a finer scale of spatial resolution and these websites are listed in the Guide.

Sustainability of plant species

The Atlas of Living Australia (ALA) website http://www.ala.org.au is used to consider the sustainability of plant species at a local site (Booth 2012). The proposed revegetation site is mapped against the current climate envelope of the focal species' distribution (e.g. mean annual temperature and annual precipitation). By using the climate projections obtained for the proposed revegetation site, the sustainability of the species and its appropriateness for future revegetation projects at that site can then be visualized (Figure 1).

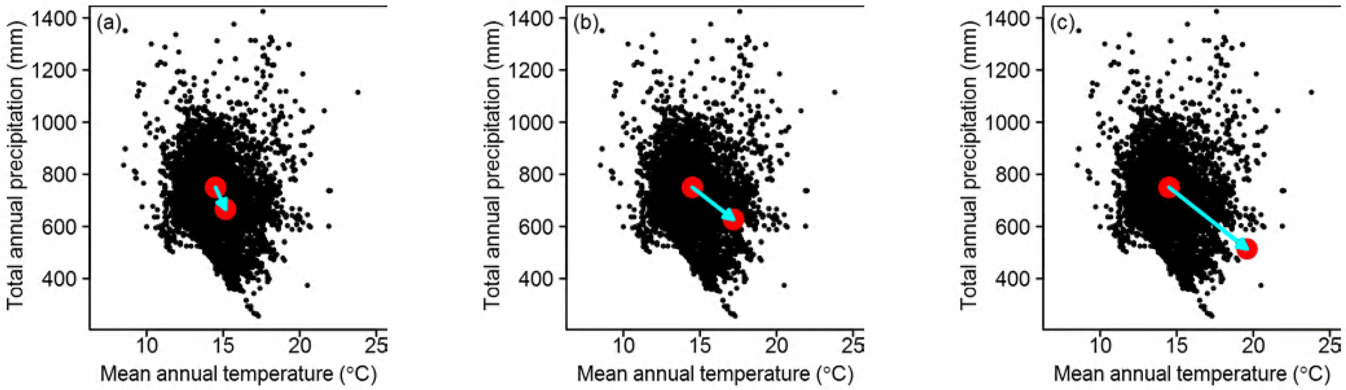


Figure 1. Examples of possible future shifts in species' sustainability for revegetation projects at a proposed revegetation site: (a) the site should remain suitable for the species (b) the site may be at the outer edge of the species' future climate envelope so consideration should be given to supplementing the local provenance with seed from other regions (c) the site may no longer be climatically suitable for the species. The black dots represent the species current distribution within its current climate envelope (mean annual temperature and annual precipitation). The enlarged red dot represents the present location of the site within the species' climate envelope. The arrow points to the projected future location of the site (the second red dot) within the species' climate envelope. Images adapted from the Atlas of Living Australia.

Sustainability of local populations – provenance strategies

Even if the species is expected to be sustainable at the site into the future, survival of the local population is not guaranteed. One of the arguments for the sole use of local provenance genetic material (seed, cuttings, tube stock or other propagules) for revegetation projects is that the local population is adapted to local conditions, and will therefore be the best to use. However, under the influence of the changing climate, local conditions have already changed and will continue to change. Plants that are adapted to local conditions and do not have enough genetic diversity to evolve, or the plasticity to adapt, may therefore become increasingly poorly adapted over the next few decades. Using suitable non-local provenance genetic material to supplement the local population should be considered in these circumstances. Several approaches to selecting suitable seed sources are discussed in the Guide.

Updates to the Guide

Over time, the websites used in the Guide will change, experience technical difficulties, or perhaps disappear altogether. Currently, the ALA is experiencing technical problems and at present, step 2.3.1 cannot be undertaken. When this problem has been rectified, you will notice that users are now required to sign in before points can be imported into the ALA. Another recent change is noted for the process taken when producing a scatterplot, step 2.3.2, the second point under 'To produce a scatterplot', step 4. Instead of entering the temperature and precipitation into the 1st and 2nd boxes respectively, use the 2nd box (Add from search). Type in Bio12 and click on Precipitation – annual (Biol12) when it appears, tick the box and '1 layer selected' will appear at the bottom. Go back to the box and type in'Bio01' and click on 'Temperature – annual mean (Bio01). Tick the box and now '2 layers selected' appears. Continue as per previous instructions.

Revegetation strategies should be updated as and when new tools and information become available. For example, a method used to identify areas for potential seed collections under climate change can be viewed on http://www.aabr.org.au/portfolio-items/using-the-atlas-of-living-australia-to-assist-provenance-selection-for-restoration-plantings-under-climate-change-trevor-booth-csiro-aabr-forum-2016/ and is detailed in Booth (2016).

Concluding Summary

The Climate-ready Revegetation Guide is a compilation of online tools currently available to assist natural resource managers incorporate the inherent uncertainties associated with climate change when planning revegetation activities. Checking species' distribution maps and climate envelopes indicate the sustainability of species and local populations under future climatic changes. The Guide, however, does not consider factors other than climate change and acknowledges that there are still many uncertainties surrounding the preparation of climate-ready revegetation.

Acknowledgements

Funding for the Guide was provided by Ku-ring-gai Council and the NSW Adaptation Research Hub – Biodiversity Node. We thank the Australian Network for Plant Conservation (ANPC) for hosting the website.

References

Booth, T.H., Williams, K.J. and Belbin, L. (2012). Developing biodiverse plantings suitable for changing climatic conditions 2: Using the Atlas of Living Australia. *Ecological Management & Restoration* 13: 274-281.

Booth, T.H. (2016). Identifying particular areas for potential seed collections for restoration plantings under climate change. *Ecological Management & Restoration* 17: 228-234.

CSIRO and Bureau of Meteorology. (2015). Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report, CSIRO and Bureau of Meteorology, Australia. Available at: http://www.climatechangeinaustralia.gov.au/en/publications-library/technical-report/.

Steffen, W., Alexander, D. and Rice, M. (2017). 2016: Global Heat Record Broken Again, Climate Council of Australia Limited. Available at: http://www.climatecouncil.org.au/2016-hottest-year-report.

Genetic rescue of the Plains Yam Daisy (*Microseris scapigera*) on the Merri Creek

BRIAN BAINBRIDGE

Merri Creek Management Committee, East Brunswick, Victoria
Email: brian@mcmc.org.au

Summary

A five-year (2011-2016) project aimed to secure the Plains Yam Daisy (*Microseris scapigera*) in the Merri Creek valley, north of Melbourne. Citizen scientists contributed to a monitoring program into the population, ecology and lifecycle of remnants that informed management and translocation trials.

Background

The Plains Yam Daisy is listed as vulnerable in Victoria. Five occurrences have been recorded for the Merri Creek catchment. All Merri Creek populations are small and vulnerable to local extinction. Three are within conservation reserves; however, illegal vehicle access, development and hydrological changes remain a threat.

The tubers of the genus *Microseris* were an important food plant for aboriginal people in southern Australia (Gott, 1983). Its recovery is important to the Merri's traditional custodians, the Wurundjeri tribe, and their aspirations for recovery of traditional ecological knowledge. A popular festival based on this cultural relationship has been established by one local community group.

Available information for Plains Yam Daisy is scanty or suspect. Taxonomic splitting and lumping has contributed to confusion about the three *Microseris* species in Australia. Few published and online resources reflect the current taxonomy. Plains Yam Daisy can be difficult to detect in the wild and cultivated plants differ markedly in appearance and growth patterns from wild plants.

When this project began, only two Merri populations had been inspected in the previous seven years and none had been mapped. Information was needed on seeding time, germination periods, response to ecological burning and reliable translocation methods. One important known fact was that the species exhibits auto-fertility (Vijverberg, Lie andBachmann, 2002), a rare feature in daisies including the other Australian *Microseris*.

Community volunteers marshalled for Plains Yam Daisy search at Kalkallo. Photo: Merri Creek Management Committee

Ecology and lifecycle monitoring

Habitat characteristics were recorded at all known populations. At the Kalkallo site, the number of leaves, flowers, seedheads and growing points were tracked across different seasons on individually marked plants. Plants were marked with aluminium tags pegged to the ground, with distance and direction of each recorded from a short starpicket that marks each 'patch'. Community volunteers assisted data collection on 106 plants over three years.

Plants occupied shallow depressions in Heavy Soils Plains Grassland and the drier of edges of Plains Grassy Wetland. Common co-occurring plants included Hollow Rush (*Juncus holoschoenus*), Brown-back wallaby Grass (*Rytidosperma duttonianum*), Prickfoot (*Eryngium vesiculosum*) and the exotic daisy, Hairy Hawkbit (*Leontodon taraxacoides*).

Almost all plants mapped in 2011 were still present in 2016 suggesting an indefinite lifespan. Plants showed a rapid growth response to late summer burning and heavy rainfall in autumn. Peak flowering occurred in autumn and early winter with a lesser peak in early summer. Successive surveys identified new plants in areas where ecological burning had occurred, suggesting fire increased reproductive success.

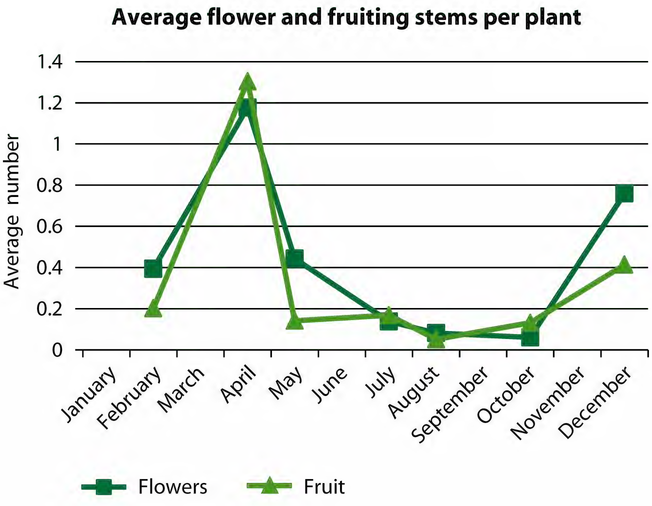
Searches

Searches were conducted at four of the five known occurrences. Based on the results of the lifecycle monitoring, searches were timed for April or May, and prioritised areas that had recently been burnt. Volunteers were trained and marshalled to methodically search quadrats at the largest population at Kalkallo.

Outcomes of searches were:

- The number of remnant plants mapped at a nine hectare reserve in Kalkallo increased from fewer than ten to over 200.
- A population of nine plants was rediscovered at Thomastown in 2013.
- Forty-nine plants were mapped at Wallan in 2015 after an ecological burn removed an overstorey of Common Reed (*Phragmites australis*).
- No plants were re-discovered at a reserve in Campbellfield, where the species was last observed in 2000. It is possible that the lengthy drought in the first decade of the century has exceeded the plant's drought threshold at this site.

Inspection confirmed the destruction by industrial development of a fifth population at Craigieburn in the mid-1980s.



Annual variation in average number of flower and fruiting stems per plant. Data MCMCKalkallo PYD search 0515

Translocations

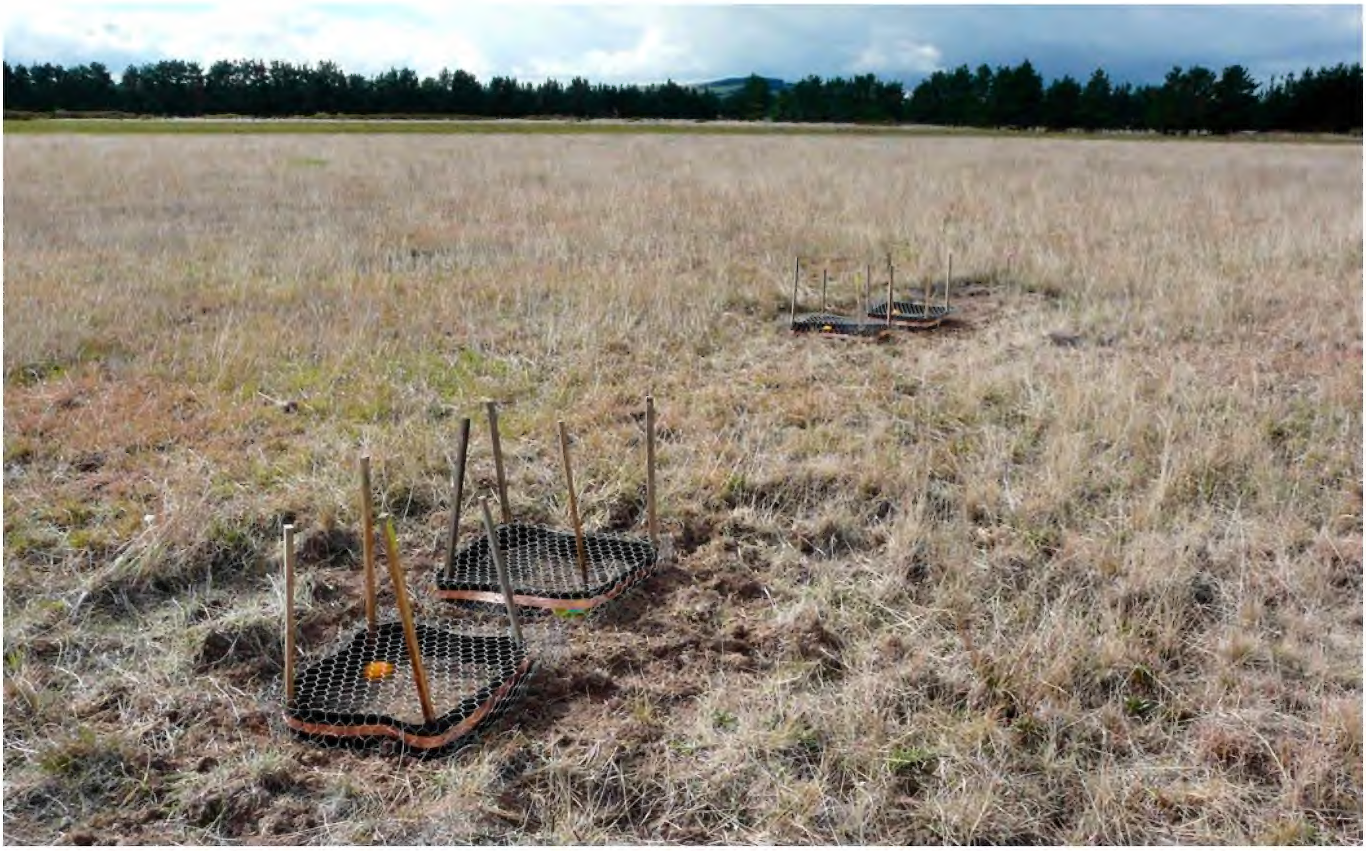
The searches identified three extant populations in the Merri separated by tens of kilometres. This suggested a 'genetic rescue' approach is needed to allow small, inbred populations to receive genes from other population such that overall genetic diversity increases.

Direct seed sowing was chosen as the translocation method as Merri Creek Management Committee's (MCMC) experience suggested that planted stock of this species fails to establish roots that can cope with heavy clay soil subject to seasonal inundation and drought. An earlier direct seeding project by MCMC successfully combined creation of gaps in the grassland sward (see Morgan, 1997) with cultivation of the soil to foster seedling tap-root development.

Seed collected from remnant plants was used to grow a seed orchard that provided seed for sowing in the following autumn.

Translocation was attempted at Kalkallo to extend an existing population; and at a grassland in Reservoir where the species was not previously recorded. Ecological characterisation of remnant sites informed site selection. Over summer, one-metre gaps were created (in areas of low floral diversity) using herbicide or scalping. The centre 0.5m x 0.5m patch of ground within each gap was cultivated to a depth of approximately 20cm and sown in autumn or winter. Germination and progress of the seedlings was tracked in succeeding months.

Fifteen patches established in 2013 and 2014 germinated well but only twenty plants survived at twelve months. Herbivory of germinants by the introduced Grey Field Slug was observed at some patches. Trampling by Eastern Grey Kangaroos was a factor in some failures.



Four of the barriers installed to protect Plains Yam Daisy seedlings from slugs and kangaroos. Photo: Merri Creek Management Committee

In 2015, thirty patches were treated and seeded (each with approximately 100 seeds). Barriers were installed consisting of a 20cm wide plastic strip, embedded in the soil and with an adhesive strip of copper foil attached (On-Guard™ Snail & Slug Barrier Insect Trap) and all covered by a cage of chicken wire. A bait station with snail pellets was inserted within each patch. These measures appeared successful in increasing survival of young seedlings although a control was not conducted to support this.

From the 2015 sowing, 81 plants remained at 338 days (approximately 2.7 % of seed applied). This represented a much more successful approach than planting. Almost all established plants were in flower at the time of the final survey.

Conclusion and further investigation

The ANPC's 'Guidelines for the Translocation of Threatened Plants in Australia' informed our information collection program for the recovery program for the Plains Yam Daisy in the Merri Creek. Our project raised further questions in particular about the genetic profile of remnants and potential of using 'gap and disturbance' treatments to promote natural regeneration.

Acknowledgements

Funding for this project came from a State Government of Victoria Communities for Nature grant. Thanks go to the volunteers from Friends of Merri Creek and the Victorian National Parks Association and to the Victorian Indigenous Nurseries Cooperative. Thanks also to my colleagues at Merri Creek Management Committee, in particular Michael Longmore and Megan Maroney.

References

Gott, B. (1983). Murnong – *Microseris scapigera*. A study of a staple food of Victorian Aborigines. *Australian Aboriginal Studies*, Issue 2: 2–17.

Morgan, J.W. (1997). The effect of grassland gap size on establishment, growth and flowering of the endangered *Rutidosis leptorrhynchoides* (Asteraceae). *Journal of Applied Ecology*, 34: 566–576.

Vijverberg, K., Lie, L., and Bachmann, K. (2002). Morphological, evolutionary and taxonomic aspects of Australian and New Zealand Microseris (Asteraceae). *Australian Journal of Botany*. 50: 127–143.

Managing imperfection in post-mined landscapes: determining the best practicable ecosystem reference sites

NIC MCCAFFREY[1,2*], PETER ERSKINE[2] AND DAVID DOLEY[2]

[1] WSP | Parsons Brinckerhoff, Melbourne.
[2] Centre for Mined Land Rehabilitation, The University of Queensland
*Email: McCaffreyN@pbworld.com

Introduction

Conventional and widespread approaches to the restoration and rehabilitation of mine sites consist of attempting to restore ecosystems to a non-degraded version of the ecosystem prior to mining. Reference or analogue sites of the target ecosystem are often used as a model or benchmark against which the progress of restoration and rehabilitation is monitored. This approach may be suitable for a handful of ecosystems and mine sites where there is a high likelihood of near-natural recovery. However, for many open cut mine sites and highly modified ecosystems, this kind of baseline has been likened to restoring the 'Garden of Eden': an unrealistic aspiration (Breed, Lowe and Mortimer 2016).

Mining frequently causes significant changes to the hydrology, topography and geology of an area (Doley, Audet and Mulligan 2012). In addition, variability in topsoil handling, seeding operations, the level of early establishment management and other site-specific conditions make predictions around rehabilitation trajectories difficult to predict, particularly in the early years. Therefore, reference sites should be used for early guidance and not as firm targets (Nichols 2004). And importantly, reference site selection should attempt to represent the post-mined landform characteristics such as slope, water holding capacity and gross chemistry (Erskine, Fletcher and Swart 2016).

In this paper, we present a method for identifying reference sites developed during 2014 and 2015 using spatial datasets combined with site-specific conditions for four coal mine sites within Queensland's Bowen Basin. Some recent publications define the role of reference sites in ecosystem restoration (Department of Industry, Innovation and Science, 2016) and methods for developing more specific restoration 'scorecards' (Neldner and Ngugi 2014). However, there appears to be no clear documentation of methods to identify practical objectives for post-mined landform characteristics, prompting the present work.

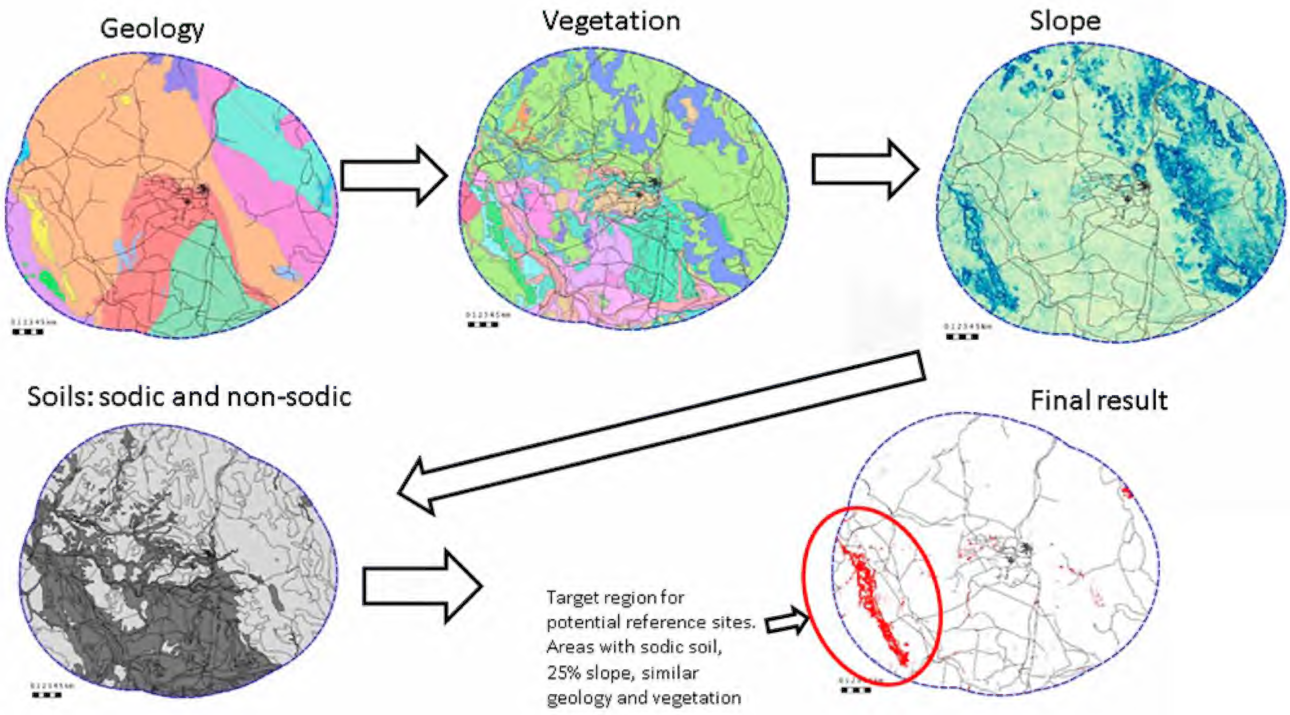
Developing the method

The development of an alternative method for gathering reference site data was part of a larger program to develop a stepwise decision guide to improve consistency in monitoring data collection at a range of sites (Erskine, Fletcher and Swart 2016).

The objective was to find sites which could emulate conditions on mine sites such as spoil heaps (e.g. steep slopes, mix of sodic and non-sodic soils, high levels of surface rock). Many mines use remnant vegetation close to mine operations, which may not always represent the final landform. We used publicly available spatial datasets to identify and prioritise field reconnaissance and selection of suitable reference sites. References site attributes of slope, broad vegetation types, soil (limited to sodic and non-sodic soils) and geology were assessed in a nominal 20 km radius study area to best represent the range of mine site conditions.

Slope was calculated using publicly available satellite data from ASTER (http://asterweb.jpl.nasa.gov/). Vegetation data used Grazing Land Management (GLM) Land Types (https://data.qld.gov.au/dataset/grazing-land-management-land-types-series), which have been correlated with Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland (Version 6b). GLMs are broadly described by their landform, soil characteristics, woody vegetation and expected pasture composition. Soil types were adopted directly from the GLMs as detailed soil mapping was not available and we were most interested in the stability and erosivity of soil types. Geology was sourced from publicly available surface geology mapping.

All the datasets were intersected using GIS to produce a map which was used for field selection of potential sites. For example, at one mine site, the aim was to have slope values between 10-20%, a mix of sodic and non-sodic soils, mapped remnant vegetation and typical surface geology (see Figure 1 for an example). Therefore, the desired environmental conditions were restricted to discrete areas and site reconnaissance was necessary to validate or refine the search for target reference sites. At selected sites, monitoring transect locations were selected randomly. At least three plots were established in each attribute category (e.g. steep slope, non-sodic soil, sandstone geology) as a measure to capture variability across transects. However, more plots would usually be required to conduct typical comparative statistical analyses.



Geology

Vegetation

Slope

Soils: sodic and non-sodic

Final result

Target region for potential reference sites. Areas with sodic soil, 25% slope, similar geology and vegetation

Figure 1. Example of spatial datasets which are combined then intersected to identify potential target regions for reference sites in an attempt to represent the best attainable post-mined landform characteristics for mine sites at the centre of the figure.

Field data collection was tailored to meet the needs of the completion criteria. This included the following metrics recorded in a 500m^2 plot:

- Landform characteristics (e.g. slope, geology, topography).
- Species richness
  - Record all vascular plant species/lifeforms within the 500m^2 plot.
  - Record the first time each plant is recorded in nested plots to develop a species-area curve.
- Tree height and density (stems per/ha).
- Biomass plots (photo comparison only).
- Photo points.

Findings and discussion

A total of 38 reference sites were established across four mine sites. Whilst there was preference to establish reference sites within mine lease boundaries, it was not always possible if the lease did not contain the required range of site characteristics. A number of reference sites were established outside of mine leases but were on titles which had management agreements with or were owned by the mining company and leased for grazing. For some sites, it proved difficult to find an adequate combination of conditions. Most reference sites were located within 5km of each of their respective mine sites.

Detailed reports and data were provided for each site and aggregated as a measure of the current condition that can be compared between years. Then this data is used to evaluate the progress of rehabilitation against the various agreed criteria.

Conclusion

The process for determining completion criteria, target ecosystems for restoration and hence the type of reference communities requires rigour and justification to reflect the unique set of challenges presented in mine rehabilitation. Reference site selection should attempt to represent the best attainable post-mined landform characteristics rather than what the site was like prior to mining.

References

Breed, M. F., Lowe, A. J. and Mortimer, P. E. (2016). Restoration: 'Garden of Eden' unrealistic. *Nature*,. 533: 469.

Department of Industry, Innovation and Science. (2016). *Mine Rehabilitation: Leading Practice Sustainable Development Program for the Mining Industry*, Department of Industry, Innovation and Science.

Doley, D., Audet, P. and Mulligan, D. R. (2012). Examining the Australian context for post-mined land rehabilitation: Reconciling a paradigm for the development of natural and novel ecosystems among post-disturbance landscapes, *Agriculture, Ecosystems and Environment*, 163: 85-93.

Erskine, P., Fletcher, A. and Swart, P. (2016). *Preparing for progressive mine rehabilitation sign-off in Queensland*, Life-of-Mine 2016 Conference, AusIMM and CMLR, Brisbane, 28-30 September 2016.

Neldner, V. J. and Ngugi, M. R. (2014). Application of the BioCondition assessment framework to mine vegetation rehabilitation, *Ecological Management & Restoration*, 15: 158-161.

Nichols, O. G. (2004). *Development of rehabilitation completion criteria for native ecosystem establishment on coal mines in the Bowen Basin*, ACARP Project No. C12045, May 2004. Australian Centre for Mining Environmental Research, Kenmore, Queensland.

The devolved grant model: Achieving lasting conservation outcomes across Tasmania

PETER STRONACH

Landcare Tasmania Inc., Tasmania
Email: peter@landcaretas.org.au

Introduction

Landcare Tasmania delivered the Landcare Biodiversity Grants (LBG) from June 2012 to September 2015. All three key themes of the Fund were addressed through this program. 1800 hectares of high conservation vegetation was protected or enhanced, threats removed from 4100 hectares and 260 hectares of revegetation or natural regeneration established to buffer high conservation vegetation across Tasmania through 62 projects and 125 sites.

Partnering with the Tasmanian State Governments Private Land and Conservation Program (PLCP) with funding from the Australian Government, and utilising our broad community network across the state, Landcare Tasmania has continued to demonstrate an ability to attract high quality projects.

Landcare Tasmania's devolved grant process has been developed overtime to improve the efficacy of monitoring and evaluation of expenditure, and is underpinned by the up-skilling of project proponents to enable long-term, sustainable conservation land management.

A step-by-step application and project monitoring framework, informed by internal review and assessment, makes the process adaptable and corrective. At a property scale, restoration and protection efforts are not necessarily straightforward. Planning is crucial and involves a number of steps to ensure successful and cost-efficient methods are employed. Capacity building is crucial, as it fosters project ownership and commitment.

Planning, follow up and landholder engagement must also be included in the protection of bushland on private land. Photo: Peter Stronach

Aspects of the devolved grants process

Our devolved grants system has several facets ensuring projects are long-term, delivered on time and are to a high quality standard.

Program development

The LBG sought projects with high conservation values through two separate approaches: a targeted closed round and a state-wide open round. Round 1 targeted recognised landholders with projects that matched the themes. Round 2 was open and state-wide and Rounds 3 to 6 accommodated under-developed projects initiated in Round 2 or projects not impacted by a later start date, new projects and for additional activities supporting previous successful projects.

Application process

A simple but informative Expression of Interest (EOI) allowed project staff to ascertain the suitability of each project proposal. Site visits by project staff helped to develop a good understanding of the land management issues and aided the facilitation of proper planning for each project entering the application phase.

From the applicant's position, a straightforward application layout ensured that a step-by-step account of formulated and costed activities. This information formed the basis for a works plan outlining management activities, methodologies and site maintenance activities.

Assessment criteria

A rigorous but efficient assessment of selection criteria is part of the review process for project proposals. Essential administrative and eligibility requirements are important starting points (e.g., land ownership, cultural heritage approvals, appropriate insurance).

Technical assessment committee members first assess and prioritise projects. The ranked projects are then considered by the steering committee made up of project partners and stakeholders, whose role is to provide broader strategic direction and align overall deliverables to project contracts.

Project tracking

Monitoring and evaluation are a fundamental part of the project team's activities delivered as part of the devolved grant model. Cross checking workplans and proposed activities with timing and expenditure of funds is also done using progress reports, site visits, ongoing staff contact and contractor logs, effectively ensuring project compliance.

Data collection, including weed mapping, ecological condition assessments, photo points, and recording of methods and success rates, allows for a better understanding of each project and how it fits into effective landscape-scale conservation management.

Extension support

Landcare Tasmania utilised a project manager, two on-ground staff members, supported by three on-ground staff members from PLCP for the LBG to liaise, collaborate and engage with landholders and groups participating in project activities. The development of an extension support network is at the forefront of using a devolved grant model to deliver landscape scale outcomes.

Discussion

By motivating potential applicants to develop and deliver technically sound projects, Landcare Tasmania is able to mobilise on-ground activities providing long-term benefits to landscape-scale change.

Efficiency

Analysis of previous Landcare Tasmania devolved grants revealed funding rounds were heavily over-subscribed, likely due to land manager needs outstripping funding availability. The EOI process screens for proposals with the best fit without burdening applicants and staff with the high levels of detail required in full proposals. Project staff then focussed on facilitating project submissions best matching program goals.

Effective and adaptive delivery

Linking expenditure to outcomes is a key way of ensuring value is achieved and recorded for projects (Hajkowicz 2009). Funding programs may experience poor reporting of value for money (Yee and Rolfe 2006) and it has been the aim of Landcare Tasmania to develop, strengthen and improve its devolved grants process to ensure better accountability. These processes ensure Landcare Tasmania delivers strategic and measured outcomes while nurturing its relationship with land managers and groups to foster the Landcare ethic and project ownership.

Risk management

Landcare Tasmania's devolved grants model attempts to minimise risk across the various components of the grant delivery process. From a rigorous assessment process to project tracking and governance of contract deliverables, reducing risk is essential when managing strategic investments. Allocating funding in stages enables timeframes to be set for projects and enabled the incorporation of periodic progress reporting requirements. The progress reporting assists project staff to identify and respond to potential delivery difficulties. The staged funding process also allowed for essential seasonal follow-up activities to be conducted over the life of a project such as weed control, infill planting or site preparation.

Onsite field support for landholders with contractor and extension is crucial for long-term conservation management. Photo: M. Newton

Importance of extension

The LBG on-ground support component is an example of facilitating excellent collaboration between applicants and professional support networks. Extension has allowed innovation and adaptation within the LBG. The contribution of local knowledge by land managers, who are provided with the opportunity to ask questions and receive feedback from the Landcare team, has maximised success.

Land managers tend to be adaptive and have responded well to this extension model. Insight gained into behavioural influences, disincentives or motivations of proponents by the on-ground presence of project staff helps motivate and guide landholder involvement (Yee and Rolfe 2006).

Conclusion

With a committed and robust devolved grant process, Landcare Tasmania delivers programs such as the Landcare Biodiversity Grants to the highest standard. The devolved grants structure adopted and refined by Landcare Tasmania increases the effectiveness of funds delivered for landscape-scale conservation management. The grant process remains open to innovation and adaptation, while limiting risk and maintaining rigour and technical integrity using a strategic, regional approach that is achieving measurable improvements to biodiversity values.

Through this process, the most valuable and strategic projects have been funded, ensuring that a care group or landholders best intentions are transformed into best practice and ensuring the greatest benefit for every dollar invested in conservation management.

Acknowledgements

This grant was delivered by Landcare Tasmania partnering with the Tasmanian State Governments Private Land and Conservation Program through funding from the Australian Government's Clean Energy Future Biodiversity Fund.

References

Hajkowicz, S. (2009). The evolution of Australia's natural resource management programs: towards improved targeting and evaluation of investments. *Land Use Policy* 26: 471-478.

Yee, S. and Rolfe, J. (2006). Evaluating the efficiency of a devolved grants program: A Central Queensland case study. Paper presented at the 50th annual conference of the Australian agricultural and resource economic society, Manly Pacific Hotel, Sydney, Australia, February 8–10.

Engineered co-existence of novel green roof habitat holds conservation promise

PAMELA J.A. SPENCER

Green Infrastructure Research Group, University of Melbourne
Email: biodiverse.landscape.design@gmail.com

Conservation opportunity in a new landscape

The extensive anthropogenic green roof landscape provides an opportunity to mimic natural habitat in a city/urban setting and support species of conservation value. Comparatively, major limiting factors to on ground habitat restoration success, such as disease transmitting vectors, herbivores, and weed competition at establishment are greatly reduced in the engineered substrate of the green roof island habitat. Importantly, in addition to demonstrated value as a biodiversity provider, extensive green roof systems provide ecosystem services such as storm water mitigation, thermal buffering of buildings and cooling of the surrounding environment (Pickett *et al.,* 2011). However, functional green roof ecosystem services and conservation potential are frequently negated, due to slow vegetation establishment and persistence of species rich cover (Van Mechelen *et al.,* 2015). This suggests that green roof conservation provision necessitates identifying an establishment practice that optimises stable habitat development within the constructed shallow resource poor substrate and desiccating microclimate habitat.

Contemporary green roof establishment practices could be contributing to poor green roof vegetation establishment and decline. The common establishment practice of pooling species from multiple habitats analogous to harsh green roof conditions, where species have evolved trait adaptations to survive, but have not evolved to share resources, has been suggested as a driver of mortality with loss of species richness and cover. Secondly, interspecies competition for resources could be magnified, through focusing species selection on few functional traits associated with improved green roof survival and optimal ecosystem service provision. A third contributor to poor green roof vegetation outcomes could be the installation of vegetation as tube/plug stock, at low density in uniform spacing to allow for growth. This installation method limits the combinations of species interactions and spatially inhibits early species interaction. With species interactions fundamental to the process of stable community assembly (Cheeson, 2000); green roof establishment practice must promote interactions such as self-thinning within species and the ability of species to modify abiotic conditions which positively facilitate neighbour establishment and survival, in order for a stable green roof community to form.

Therefore a green roof vegetation establishment practice capable of conservation provision must extend beyond the singular contemporary practice of selecting species for traits likely to confer survival and ecosystem service provision as individuals, to a practice which promotes species interaction and community self-organisation into stability.

Conservation habitat requires community co-existence

The stable, species rich cover required to support species of conservation value on green roofs, is achieved in natural communities when species co-exist. Species functional ability to compete for resources is a condition for stable co-existence described by ecological Niche Theory (Tilman, 1982). Additionally, stable co-existence is demonstrated when species densities recover under environmental pressures and growth occurs in favourable conditions. Community assemblage into stable co-existence requires three broad conditions/mechanisms (Cheeson, 2000; Thorn *et al.,* 2016):

- Early community assembly through intra and inter species interactions that organise species distribution and abundance, requiring a high density of propagule input.
- Resources are shared spatially and temporally, which is possible when functional diversity is high through morphological and phenological variation between species.
- Supportive facilitator and neutral species interactions outweigh competitive interactions.

Importantly, the stable species rich cover present in a co-existing community is self-perpetuating, via positive feedback to the conditions and mechanisms that create this community character. (Figure 1).

Translation or enhancement of co-existence from a natural habitat to a novel green roof habitat could be achieved by focusing on plant selection from a single habitat pool, maximising functional diversity, optimising potential facilitation of species and excluding competitive species or guilds known to reduce species richness (Figure 2). Additionally, an establishment method must provide a random distribution of propagules at a density that optimises species interactions and thus early community organisation into co-existence; seeding achieves this, in

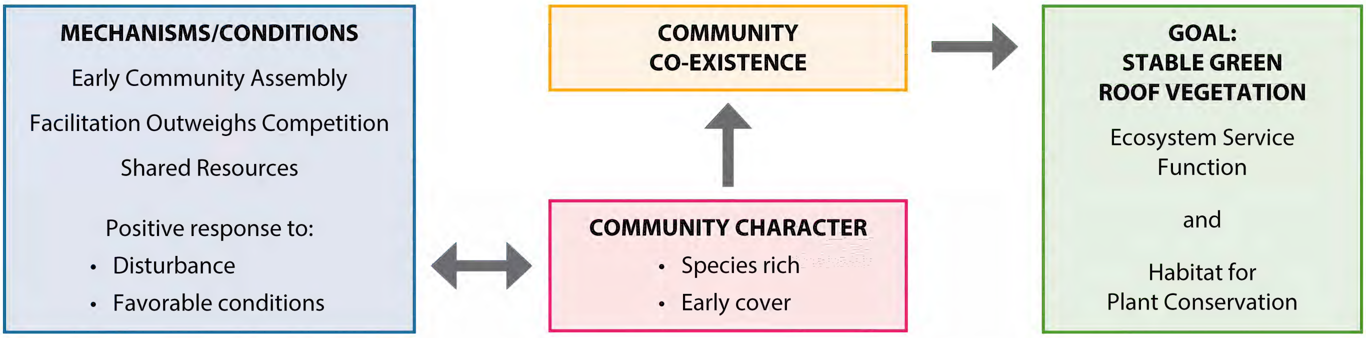


Figure 1. Conceptual model for the early establishment of stable species rich green roof vegetation cover. This is based on promotion of mechanisms and conditions that deliver community co-existence, as described through Niche Theory.

contrast, uniform low density planting of plug/tube stock does not. Seeding green roof mats or modules in nursery conditions may result in a community assembly that poorly tolerates green roof conditions on transference, with vegetation decline resulting. Whereas direct seeding at the green roof site would enable community organisation specific to any heterogeneity in green roof abiotic conditions. These conditions and mechanisms suggest a process by which co-existence may be engineered into a novel green roof habitat, with potential to support species of conservation value. Importantly, contemporary plant selection based on individual plant traits could be adopted within the mechanisms of engineered co-existence, with potential synergistic benefit to green roof habitat stability and ecosystem service.

Engineered co-existence across multiple conservation applications

Viewing contemporary green roof vegetation plant selection and establishment practice through the ecological field of community co-existence, offers explanation as to why these practices often produce poor vegetation outcomes, and indicates a process through which novel green roof habitat supportive of species conservation could be created. Green roofs as an engineered conservation tool may be engaged as: a seed supply source, in the ex-situ conservation of flora, and additionally as habitat refuge to invertebrate and avian fauna. Beyond green roofs, engineered co-existence of novel communities has broad conservation application, such as in protection of remnant habitat patches, as a barrier against weed and pest invasion and as a microclimate buffer supporting peripheral vegetation. Another application could be in lifting horticultural production of native seed crops, thereby reducing the need for wild harvest and consequently contributing to seedbank conservation. The success of engineering co-existence into novel green roofs will rely upon refining this process relevant to local context and informing industry practice. The flexible creativity involved with engineering co-existence into novel green roof habitat holds much promise towards addressing biodiversity and conservation challenges inherent to city landscapes.

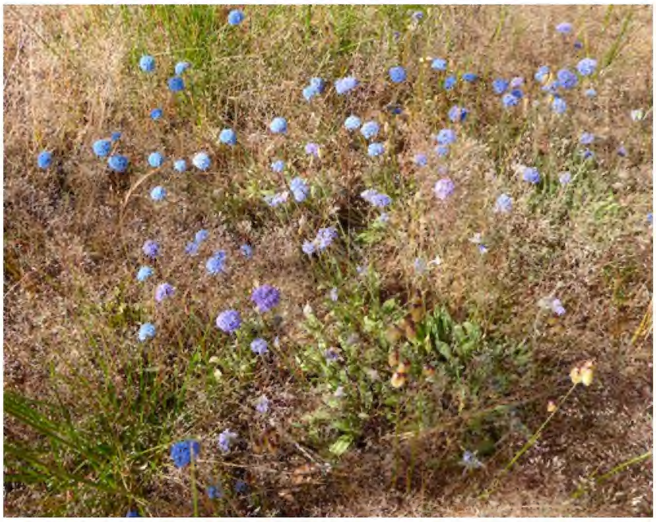


Figure 2. The Victorian Volcanic Plains endangered grasslands; a species pool for novel green roof grassland. The dense species rich community character indicates potential ecosystem service and conservation provision. Floral feature: *Brunonia australis* J. E. Sm., Midland Highway, Clarendon, Victoria, 1st December 2016. Photo: Pam Spencer

For further information see –
Orcid id: 0000-0002-1452-1099
https://thegirg.org/our-people/pamela-spencer/

References

Chesson, P. (2000). Mechanisms of maintenance of species diversity. *Annual. Review. Ecology Systems.* 31, 343-366

Pickett, S. T. A., Cadenasso, M. L., Grove, J. M. and Boone, G. (2011). Urban ecological systems: Scientific foundations and a decade of progress. *Journal of Environmental Management* 92, 331-362

Thorn, S., Bassler, C., Bernhardt-Romermann, M., Cadotte, M., Heibl, C., Schafer, H., Seibold, S. and Muller, J. (2016). Changes in the dominant assembly mechanism drive species loss caused by declining resources. *Ecology Letters* 19: 163-170.

Tilman, D. (1982). Resource Competition and Community Structure. Princeton University Press, Princeton.

Van Mechelen, C. M., Van Meerbeek, K., Dutoit, T. and Hermy, M. (2015). Functional diversity as a framework for novel ecosystem design: the example of extensive green roofs. *Landscape and Urban Planning* 136, 165-173

Friends of the Royal Tasmanian Botanic Gardens Grant Recipient Report 2016 – Attending the 11th Australasian Plant Conservation Conference (APCC11)

APCC11
11th Australasian Plant
Conservation Conference 2016

LORRAINE PERRINS
Royal Tasmanian Botanical Gardens

The Australasian Plant Conservation Conference (APCC) is a biennial conference organised by the Australian Network for Plant Conservation (ANPC). Regular readers of *Fagus* would remember that in 2014 the Royal Tasmanian Botanical Gardens hosted the APCC10 and the Friends played a major role in providing logistical support and tours for the visiting delegates. I was involved in the organising committee and gained many insights into the management of a national conference, however due to my close involvement, was unable to attend many of the presentations or utilise the opportunity to network with the visiting delegates. The ongoing financial constraints in Government agencies mean that the opportunities for horticultural staff to attend conferences are extremely rare, which is why I was delighted to receive a Friends grant to attend the APCC11.

The APCC11 was hosted by the Royal Botanic Gardens Victoria and La Trobe University and was held in the National Herbarium of Victoria. The overall theme was "*New Approaches to Plant Conservation Challenges in the Modern World*", with subthemes addressing topics such as:

- Assisted colonisation as a practical tool for climate change mitigation.
- Rethinking landscape restoration: seed production, provenance, conservation planning.
- Holistic conservation – the role of mutualisms in ensuring functional ecosystem recovery (pollinators, soils).
- Rescuing small populations from extinction.

Mr Gregory Andrews (Commonwealth Threatened Species Commissioner) presented the keynote address announcing that the Kardashians represented one of the biggest threats to endangered species, stating that more people know about what this celebrity family ate for breakfast than that Australia has the worst rate of extinctions in the world. The competition to gain attention (and therefore support) for our rare and threatened species was, he believed, a big issue, and something that he is trying to address, (many of you may already be aware of his very active Facebook and Twitter postings). He stated that another problem was what he called the "Gollum" effect, or rather that conservationists can be "too precious" about maintaining the status quo and keeping pure genetic lines intact, pointing out that with the uncertainties of a changing climate, methodologies such as assisted colonisation and the augmentation of existing populations will have to be considered into the future. He noted that Botanic Gardens played a major role in the conservation of many threatened plants, particularly recognising the Australian Seed Bank Partnership as a critical component of this effort.

The Australian Network for Plant Conservation Inc
www.anpc.asn.au

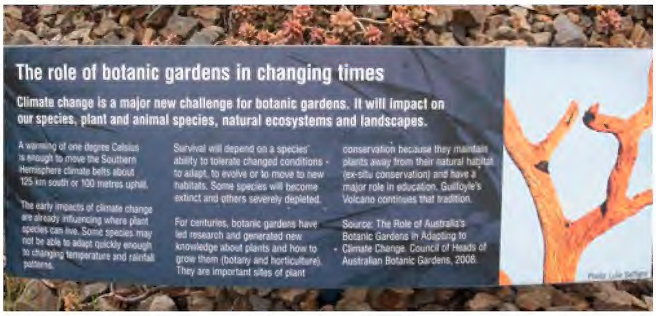
APCC11 Keynote Speaker, Threatened Species Commissioner Gregory Andrews, talking about the 30 plants the federal government is aiming to save under the Threatened Species Strategy. Photo: Jo Lynch

There were many interesting presentations, and some of the poignant and thought-provoking topics, for me were:

- The recognition that we are living in the middle of an extinction debt, i.e. many future extinctions, particularly in regards to plants, will be due to past events. An example of this is that 75% of Western Australia's flora is very long-lived e.g. 100yrs+, the recruitment of seed from some species may be comprised in the future due to unfavourable climate conditions or impacts from pests and diseases, and it will take many years for the ultimate extinction of these species to be noticed as the parent plants will remain in the landscape for a long time. A Tasmanian example of this could be *Eucalyptus gunnii* ssp. *divaricata* (Miena Cider Gum) which occurs in the Central Plateau. The mature trees of this species have been slowly deteriorating over a number of years to the point that many do not now set seed. Seedlings of this species are intensively browsed causing an overall decline in the population. This combined with the additional stresses of a changing climate and fragmentation will likely result in this species becoming extinct in the wild in the medium term. A critical practical tool to generate awareness of these changes was the use of photo monitoring to show clearly over time how areas change, as well as allowing controlled access to recently burnt or disease-impacted areas and interpreting the scene so people can gain a greater understanding of the changes afoot and how nature responds.
- There were discussions revolving around the issue of translocating species away from their natural populations, termed 'assisted migration', if these areas were not considered suitable habitat in the longer term. An example provided of this was the species *Ballantinia antipoda (*Southern Shepherds Purse), a small annual herb endemic to Victoria and Tasmania. The species has disappeared from almost all sites from which it was known and has been declared extinct in Tasmania. It currently exists only at a single location at Mount Alexander in central Victoria. The long-term suitability of the site where it is occurring is in question with plans to possibly reintroduce it to suitable areas in Tasmania as an option for its on-going survival. The overall lack of good data on the success of translocations was highlighted as a major issue and the Australian Network for Plant Conservation will be addressing this gap in the near future.
- It is generally accepted that by 2070 some biotas will disappear and that much of the plant diversity we have today will only be conserved thorough cultivation or in seed banks.
- New novel "habitats' will have to been considered if we are to maintain biodiversity in our urban areas. It was noted that green roofs in Germany are increasing at a rate of 1,100ha per annum and provided good habitat for mobile species such as lizards and birds. Green roofs were considered to be ideal for some threatened plant species such as terrestrial orchids and annual herbs adapted to hot dry conditions and which rely on porous, low nutrient substrates.
- The health benefits of human interactions with nature have been well documented and there is considerable evidence that through our gardening practices, humans and ornamental plants have developed a *"mutualism"* (*mutualism* is the way two organisms of different species exist in a relationship in which each individual benefits from the activity of the other).

On my many walks around the Royal Botanic Gardens Victoria, Melbourne, a number of things about this wonderful garden impressed me, these being:

- The excellent interpretation throughout, from the visitors map to individual collections, some samples of which are highlighted below -



The role of botanic gardens in changing times

Climate change is a major new challenge for botanic gardens. It will impact on our species, plant and animal species, natural ecosystems and landscapes.

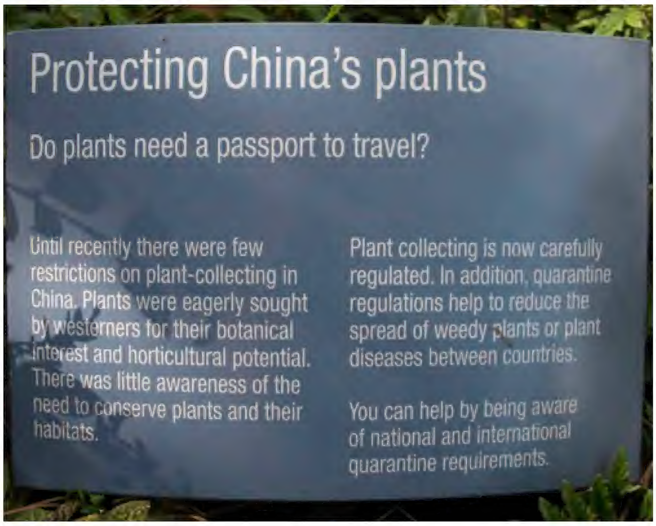
A warming of one degree Celsius is enough to move the Southern Hemisphere climate belts about 125 km south or 100 metres uphill.

The early impacts of climate change are already influencing where plant species can live. Some species may not be able to adapt quickly enough to changing temperature and rainfall patterns.

Survival will depend on a species' ability to tolerate changed conditions - to adapt, to evolve or to move to new habitats. Some species will become extinct and others severely depleted.

For centuries, botanic gardens have led research and generated new knowledge about plants and how to grow them (botany and horticulture). They are important sites of plant conservation because they maintain plants away from their natural habitat (ex-situ conservation) and have a major role in education. Guilfoyle's Volcano continues that tradition.

Source: The Role of Australia's Botanic Gardens in Adapting to Climate Change. Council of Heads of Australian Botanic Gardens, 2008.



Protecting China's plants

Do plants need a passport to travel?

Until recently there were few restrictions on plant-collecting in China. Plants were eagerly sought by westerners for their botanical interest and horticultural potential. There was little awareness of the need to conserve plants and their habitats.

Plant collecting is now carefully regulated. In addition, quarantine regulations help to reduce the spread of weedy plants or plant diseases between countries.

You can help by being aware of national and international quarantine requirements.

Photos: Lorraine Perrins

- The interesting ‘plant combinations’ in garden beds, which was visually very rewarding, and anyone who has visited these gardens in recent years would be familiar with the work of Landscape Architect Andrew Laidlaw on the development of many parts of the gardens including the Ian Potter Foundation Children’s Garden and Guilfoyle’s Volcano.
- The Aboriginal Australians connection to the site was very apparent. Maps available for visitors have a clear “Welcome to Country” from the local clan and daily tours are offered by Indigenous guides, including a traditional smoking ceremony welcome and insights into their use of plants for food, tools and medicines. There is also an area called the Long Island Garden which has been recreated to be a time capsule of the original vegetation that existed along the Yarra River 150 years ago, with a self-guided walk highlighting the important indigenous plants to the region.

I chose to join the conference field trip to the magnificent Royal Botanic Gardens Victoria, Cranbourne, looking at the “Role of Botanic Gardens in Applied Conservation”. This trip highlighted 3 main foci of plant conservation carried out at Cranbourne, these being:

- Threatened Orchid Conservation Research.
- Climate Adaptation Research Plots.
- Managing remnant vegetation for conservation of ground fauna.

This trip, (along with a privately organised visit to the nursery facility at the RBGV Melbourne), was where I was able to gain insights into some practical applications. We were shown the native terrestrial orchid laboratory and growing area, where we were introduced to key staff and volunteers for the Threatened Orchid Conservation project. The RBGV has been involved in *ex-situ* terrestrial orchid propagation and growing since the early 1990s, and more recently this has evolved to include some very successful reintroductions back into the wild. As I am directly involved in growing on the Tasmanian terrestrial orchids for a similar program that Dr Magali Wright and Dr Nigel Swarts have been coordinating at the RTBG, it was extremely informative to see first-hand a program that has been running for a long period of time.

Conservation work in Tasmania can have limited scope for networking ideas and practicalities compared to projects on the mainland. National conferences are an excellent way to learn and engage with the many successes and failures across the country. We are already witnessing the impacts of a changing climate on many of Tasmania’s natural ecosystems and I envisage that the work of the RTBG in both its *ex-situ,* and also *in-situ*, plant conservation practices will increase into the future. How we manage this need effectively will largely be a result of partnerships and collaborations. The opportunity that the ANPC conferences provide to network with colleagues at similar institutions cannot be underestimated and I would like to thank the Friends of the Royal Tasmanian Botanical Gardens for providing me the financial support to attend this conference.

Orchid Conservation Program PhD Student Marc Freestone explaining some of the work involved with successfully growing native terrestrial orchids at the facility at the RBGV, Cranbourne. Photo: Lorraine Perrins

Report on APCC11 Conference Field Trip to Wilsons Promontory National Park

GEOFF ROBERTSON

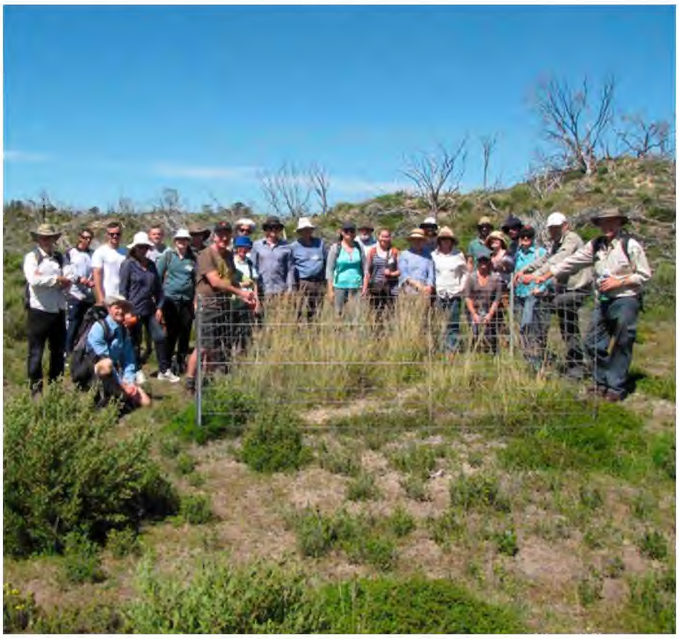
Friends of Grasslands

I took this photo at the request of John Morgan (Plant Ecologist, Department of Ecology, Environment and Evolution, La Trobe University) who is on the left of the enclosure. It shows the people on the APCC11 Conference Field Trip '*Grassy Woodland Restoration at Yankee Isthmus, Wilsons Promontory National Park*'. This followed on from his presentation at the conference. Apart from showing a lot of fascinating people, the photo also illustrates very well the issues associated with managing the vegetation in the area.

Originally this was a grassland, possibly more correctly a cultural grassland landscape. Following the removal of original custodians, use of fire management and later pastoral management, the land became dominated by tall Coast Tea-tree (*Leptospermum laevigatum*). Experiments were conducted to remove the Teatree through hot fire. The first fire resulted in the Coast Tea-tree rapidly returning after fire, but in the second trial it didn't. This result was down to timing. The first fire took place in November after the Coast Tea-tree had seeded and after the fire the enormous seed store allowed the Coast Tea-tree to regenerate. The second fire took place in early October before the Coast Tea-tree had set seed; there was much less seed available for regeneration (likely last years' seed had been devoured). Remnants of the Coast Tea-tree may be seen in the background. This is clearer in the second photo which shows an area where the Coast Tea-tree was burnt in the foreground and not burnt in the background.

The second issue is that of overgrazing by macropods, wombats and deer. They have eaten down the grass leaving a low shrubby storey. The enclosure shows what would happen if grazing animals were excluded. With more moderate grazing, grasses would be more dominant and the grassland could be managed by a mix of grazing and cool burning; without grass cool burns are likely not possible.

All very fascinating.



Attendees on the APCC11 Conference Field Trip to Wilsons Promontory National Park standing around an enclosure which shows the resulting grass regeneration when grazing animals are excluded. Photo: Geoff Robertson

This field trip was generously sponsored by Ecology Australia.

ECOLOGY AUSTRALIA

Ecology Australia is a leading Australian ecological consultancy, recognised for setting and maintaining high professional standards. Operating since 1978, our experience has given us an enviable reputation for quality, integrity and value for money. Our team of highly qualified ecological consultants offers a comprehensive range of services in terrestrial and aquatic ecology, undertaking a diverse range of projects for clients in the public and private sectors. Our depth of expertise spans a wide range of biological issues and enables us to efficiently determine the level of investigation required for any project.

88b Station St, Fairfield VIC 3078
03 9489 4191
ecologyaustralia.com.au

JAS-ANZ

@Ecology_Aus

Quality Approved ISO 9001
Safety Approved AS/NZS 4801
Environmental Approved AS/NZS ISO 14001

News from the Australian Seedbank Partnership

ASBP Partnership update

ANNE COCHRANE
Science and Conservation Division, Department of Parks and Wildlife, WA
Email: anne.cochrane@dpaw.wa.gov.au

Lucy Sutherland collecting seeds for *Spyridium coalitum*. Photo: Lucy Sutherland

Late last year the former Australian Seed Bank Partnership (ASBP) coordinator, Dr. Lucy Sutherland, accepted the position of the Director, Botanic Gardens of South Australia after guiding the seed partnership for the past six years. Lucy came to the role of ASBP coordinator with no seed banking experience at all but considerable expertise in sustainable development and environmental management. Amongst other occupations Lucy had worked as a conservation and education project officer for Botanic Gardens Conservation International where she facilitated project development and management with collaborative partnerships and other stakeholders. Lucy was thus eminently qualified to become coordinator of an alliance of 12 organisations that brought together expertise from Australia's leading botanic gardens, state environment agencies and NGOs to work on strategic solutions to deal with the multitude of threats facing Australia's biodiversity.

On her arrival in the job in 2010, Lucy had to contend with a diverse group of managers, scientists, seed collectors and technicians from around the country and she did this in a most capable manner, whipping us into shape and putting us on the path to becoming a very effective and cohesive partnership that has made important contributions to understanding and conserving the Australian flora.

Lucy encountered many challenges over these past six years, particularly around securing greater resources to support the ASBP efforts. Under Lucy's guidance the partnership collaboratively assisted Australia to deliver on Targets 8 and 16 of *the Global Strategy for Plant Conservation*, whilst also providing a significant contribution to the Millennium Seed Bank Partnership to reach its 2020 global targets for *ex situ* conservation. Together the partnership created a distributed database with the Atlas of Living Australia that helps with national conservation planning and management, and provides information for researchers. Lucy helped us raise the profile of seed banking and Australia's ASBP collaborations and shared our collective knowledge, through national and international forums, stories for social media and networking and collaborating with a range of Associates. Lucy also raised the profile of seed banking with the Australian government as part of integrated conservation management specifically in terms of threatened species recovery and biosecurity management. Lucy instigated synergies with agricultural and conservation seed banks and assisting the partnership to form an alliance with the Society for Ecological Restoration Australasia to contribute to national standards for the practice of ecological restoration in Australia.

These are just some of Lucy Sutherland's many achievements on behalf of the ASBP members. She will be sorely missed, but in her place Damian Wrigley from the Department of Environment and Energy has taken up the position of ASBP coordinator. Damian has many years' experience in developing and implementing environmental policy and programs within the government. We welcome Damian to the role.

The position of ASBP coordinator is supported by Parks Australia, Department of Environment and Energy and located in Canberra at the Australian National Botanic Gardens.

ANPC Member Profile

CHRISTOPHE TOURENQ AND TIM FIELD
Banrock Station, www.banrockstation.com.au

What is your current position?

Christophe: I am Wetland and Conservation Manager for the Banrock Station Ramsar Wetland Complex that covers 1,400ha of mallee and floodplain habitats along the Murray River in the Riverland, SA. Wrapped around some 300ha of vineyard, it is an area of national and international importance for the conservation of the unique fauna and flora that thrives along the river. It is also culturally important for its indigenous and modern history. My role is to ensure that the unique ecological and cultural characters of the site are maintained and enhanced, through monitoring and habitat restoration programs, while providing a safe and enjoyable experience for our visitors.

Tim: I am the Ecologist for Banrock Station and my role is to implement the on ground aspects of our landscape and biodiversity programs in addition to exploring the station to document and share our three hundred plus flora species with the world.

What project(s) are you working on at the moment?

In partnership with local and national government and non-government organisations, we are involved in several projects on Banrock Station and regionally, including:

1. The (*EPBC Act listed*) Spiny Daisy (*Acanthocladium dockeri*) Recovery Program with SA Department Environment Water & Natural Resources (DEWNR), Trees for Life, regional Landcare groups and National Trust SA.
2. Floodplain restoration through environmental watering with the Commonwealth Environmental Water Office (CEWO).
3. Mallee and black box woodlands restoration with local schools and Riverland West Landcare, and through the Commonwealth 20 Million Trees campaign with Australia Landcare and Trees for Life.

Christophe and Tim, in front of the Banrock Station flood ladder during the 2016 flood event. Photo: Carl Doubikin

4. Release of the rabbit haemorrhagic disease virus (RHDV1 K5) with the Invasive Animals Cooperative Research Centre (ICRC).
5. Bat conservation with the Mid-Murray Landcare .
6. Fungi surveys with Dr Pam Catcheside from the State Herbarium of South Australia.

How did you end up working in plant conservation?

Christophe: Being more a fauna specialist, I came late into plant conservation while working on protected areas projects in the Middle East. Upon our arrival in Australia, I joined the local landcare groups in the Illawarra where my wife originates from, and measured the amplitude of impact of invasive exotic plants species on the Australian landscape and biodiversity. I call this impact a "rampant silent" one as making less "noise", *aka* headlines, than the more visible feral cats and foxes' ones! A site visit and discussion with DEWNR staff (including the last ANPC member profile, Doug Bickerton) in 2013 triggered my interest on the formidable story of the Spiny Daisy.

Tim: I have long had an interest in flora but my career initially headed towards vertebrate pest management and fauna survey. In 2009 I was fortunate to find myself involved with a landscape scale restoration program on Kangaroo Island which included a number of threatened species. It was there I met a couple of passionate people with a love of flora that allowed my interest to bloom. I have carried that experience through to my current role and am now focusing on restoring whole habitats including large numbers of understory species that suffered heavily from historic grazing pressures.

Banrock Station is a Small Business member of the ANPC. Why do you think the ANPC is important and what do you see as our priorities?

We see the ANPC playing a role in creating the opportunity for us to connect with experts in the field of plant conservation. It allows us to gather resources and improve our knowledge and methods in a way to ensure we are armed with the most up to date and relevant practices.

What is your favourite plant and why?

Christophe: I am fascinated by the majestic hundred years old red gums that escaped logging along the Murray River: under a blue sky, with a crisp autumn light piercing through their foliage, their reflection on the river, they are just magnificent. But I must say, the Spiny Daisy has to be my favourite! Not because, as a colleague pointed out: "*she is like me: a discrete yellow flower, grey and spiky*", but because most of all, it is a remarkable story that would make a great Victorian era book, combining history and drama with the Burke and Wills expedition and the enigma of a species disappearance and reappearance. In these times of "*doom and gloom*" for biodiversity conservation worldwide, the Spiny Daisy project shines as a successful story with an exemplar and efficient partnership between a private agribusiness (Banrock Station), and government and non-government organisations. It is a privilege for a conservationist to be involved in such project.

Tim: Since developing my identification skills, I find a lot of joy unravelling the mystery of different habitats wherever I go. I love finding plants growing in almost impossible conditions and marveling at how they have been able to endure. Banrock Station has some deep dunal sandy places where historically large stands of *Callitris gracillis* ssp. *murrayensis* once stood before the land was cleared. They are one of my favourite species and we have a small remaining stand of them, of which many have trunks that have grown in a knotted, twisted gnarly manner and yet they still flourish. I think about the changes to the landscapes these old warriors must have seen when I am out collecting seed from them and before I know it I have a bucket full.

ANPC Workshop Reports

'Oh for the love of Banksia trees' Bring Back the Banksias & Friends of the Forgotten Woodlands Silver Banksia Information Workshop at Lake Bolac

A recent workshop was held on February 24, 2017 at Lake Bolac, Victoria to provide an update on progress of various Silver Banksia (*Banksia marginata*) research and restoration projects on the Victorian Volcanic Plains (VVP) and beyond.

By sheer coincidence it was the 274th anniversary of Joseph Banks' birthday in 1743, adding to the significance of a day that focussed on the issues of Banksia decline, genetics, and ecological understanding.

The workshop, organised by Aggie Stevenson from Glenelg Hopkins Catchment Management Authority (GHCMA) and Friends of the Forgotten Woodlands (FoFW), and Martin Driver from the Australian Network for Plant Conservation (ANPC), brought together almost 70 interested people from across Victoria and interstate including landowners, Landcare practitioners, seed collectors, nursery suppliers, propagators, researchers, project officers and consultants.

The aim of the workshop was to showcase recent happenings with Silver Banksia research, mapping, genetics and seed orchards established to encourage efficient propagation and reverse decline of the species.

Dr Adam Miller from Deakin University, Nature Glenelg Trust and FoFW reported on his preliminary findings on the genetic structure of the scattered populations of Silver Banksia populations on the VVP. With funding provided by the GHCMA through the Australian Government's National Landcare Programme, Dr Miller and FoFW have collected samples from 22 selected Silver Banksia populations across the VVP. Encouraging analysis results from the collection indicate the problem of Banksia declinecan be overcome.

Dr Miller's work indicates remaining populations on the plains have a relatively even genetic spread. This genetic distribution is consistent with the previous widespread but patchy distribution, and long lifespan. Past clearing and continuous grazing has prevented regeneration in most populations.

Dr Miller explained it is genetically concerning that Silver Banksias have become confined to small fragmented populations and individual plants. "However, all is not lost. It hasn't been left too late to turn things around. There's still lots of hope," Dr Miller told the gathering. "There is still enough genetic diversity in existing populations to prevent species extinction," Dr Miller said. However, he explained that to bolster the gene pool and grow populations, smart genetic management and intervention is required. "We need to move genes around to maximise genetic diversity and the adaptive capacity of local populations. Genes doing well in the past might not necessarily do well in future. Genes from some non-local sources may do better," Dr Miller explained. "There's a need to mix things up and let natural selection then happen".

This positive news demonstrates the importance of establishing Seed Production Areas (SPAs), and combining and capturing existing diversity for future seed production and restoration projects.

Dr Steve Sinclair from Arthur Rylah Institute and FoFW presented historical evidence of past distributions of Silver Banksia and other woodland species, highlighting the level of decline that has taken place since European settlement and pastoralism. Possible threats contributing to the decline of this keystone species include livestock, rabbits, superphosphate intolerance, fungal disease, pollination failure, frequent burning, drought, as well as issues arising from kangaroos, black cockatoos and phalaris.

Simon Heyes from LaTrobe University outlined his initial research work on site population age class structures across the range of Silver Banksias on the VVP. His project has collected demographic data and will scientifically analyse possible reasons for the decline of Silver Banksias. Again this presents a positive outlook; mostly there has been at least some scattered regeneration across the sites sampled. This work raises some questions about seed production, ecology and constraints on field regeneration.

Speakers Will Ford (Trust for Nature, NE) and Cathy Olive (Euroa Arboretum) explained how the Silver Banksia populations in north-east Victoria and Goulburn Broken CMA are seriously depleted. Restoration efforts can no longer depend on remnant populations and growers need to outsource seed supplies. Will outlined a new project that will follow the genetic review process of existing populations in conjunction with North East CMA, Wooragee Landcare and Norman Wettenhall Foundation. Cathy outlined the history and management of the Silver Banksia seed production project and the future inclusion of further north east seed populations.

Participants at the Lake Bolac workshop 24 Feburary 2017. Photo: Martin Driver

Bill Weatherly and Tim D'Ombrain talked about the formation of the FoFW group and its role in initiating on-ground restoration projects and seed production sites for Silver Banksia. To get approval for the establishment of seed orchard sites along roadsides, it has been critical to gain support from adjoining landholders and the Country Fire Authority, as well as partners, including VicRoads. FoFW have established five seed orchard sites on both private and public land where Silver Banksia as well as Drooping Sheoaks and Sweet Bursarias are being planted and records of seed sources kept.

A key milestone for FoFW has been the development of a central Silver Banksia database to be used for the co-ordination of seed collection and seed orchard development planned across Victoria. The database will store all population and location data collected for *Banksia marginata*. Martin Driver called for other Catchment Management Authorities to get on board.

Acknowledgment was paid to the value of restoration work done in the 1980's by Liz Fenton, Rod Bird and others at sites like Lake Linlithgow near Hamilton.

A concluding workshop segment identified the need for a co-ordinated and planned approach, resolving to investigate the extension of Silver Banksia genetic works into North Central, Gippsland and Wimmera CMAs, and South Australia. It was also resolved to seek further funding from the Norman Wettenhall Foundation for Bring Back the Banksias project communication and to investigate a future workshop information series including the Friends of the Forgotten Woodlands.

For further information on presentations please contact Martin Driver, ANPC, projects@anpc.asn.au or Aggie Stevenson, GHCMA, a.stevenson@ghcma.vic.gov.au

Thanks go to Aggie Stevenson, Bill Weatherly and the range of project sponsors and supporters that made the day possible, including the Norman Wettenhall Foundation.

Katrina Weatherly, Glenelg Hopkins Catchment Management Authority and Martin Driver, ANPC

News

ANPC Volunteer opportunity currently available!

Are you or someone you know looking for volunteer work in the Canberra region while studying, searching for a job or during retirement? A volunteer position at the ANPC's National Office is now available one day a week on **Thursdays from 10am to 2pm**. The office is based in the Crosbie Morrison Building at the Australian National Botanic Gardens. Volunteers receive a free annual parking permit for the Gardens and free ANPC membership! Specific Duties: office administration; marketing and promotion; website updating and maintenance; membership – assisting new and existing members, updating database etc; editing and production of Australasian Plant Conservation; and helping to organise conferences and workshops. What the position offers: an opportunity to increase skills, confidence and employment prospects; valuable experience working for a national non-profit organisation; experience in using various computer software packages; administration and organisation skills; scientific writing and publishing skills; and exposure to Australian plant conservation issues and projects. http://www.anpc.asn.au/volunteer

The Australian Native Seed Industry Review workshop – summary report released

This workshop was held at the Royal Botanic Gardens Victoria, Melbourne, as part of the APCC11 conference on 18 November 2016 and sponsored by the Rural Industries Research & Development Corporation.
This 'Call to Action' Workshop drew on both Dr Paul Gibson-Roy's plenary conference review of the American native seed industry and the pre-conference industry-wide on-line survey, along with workshop participation, and identified some of the key issues, gaps and opportunities in the Australian native seed industry. The ANPC is now seeking further support to address the issues and actions identified and to assist in creating a more effective native seed supply industry. http://anpc.asn.au/APCC11/workshop

Albert Morris Ecological Restoration Field Trip and Award – Broken Hill, 22–24 August 2017

Many interested people from all over Australia are converging on Broken Hill in early Spring to celebrate the 80th anniversary of one of the world's earliest restoration projects: the Broken Hill Regeneration Reserves.
This will mark the inauguration of the Albert Morris Ecological Restoration Award. The ANPC is proud to be co-hosting this event with the Australian Association of Bush Regenerators, Greening Australia and the Society for Ecological Restoration Australasia. Sponsorship opportunities are now available.
http://www.aabr.org.au/event/albert-morris-ecological-restoration-field-trip-and-restoration-awards/.

EUCALYPT AUSTRALIA

Eucalypt Australia, a Philanthropic Trust dedicated to promoting eucalypts. Visit our web site for information on:

- Our small grant program
- National Eucalypt Day celebrations
- Special projects
- Sponsored conservation projects
- Sponsored education projects
- Sponsored eucalypt research

Contact us:
E contact@eucalyptaustralia.org.au T 03 9005 7425
@EucalyptAus facebook.com/EucalyptAustralia

eucalyptaustralia.org.au

Victoria's biodiversity plan released

The Victorian Government recently released **Protecting Victoria's Environment – Biodiversity 2037**, Victoria's plan to stop the decline of native plants and animals and improve the natural environment so it is healthy, valued and actively cared for. Coupled with reviews of the *Flora and Fauna Guarantee Act 1988* (FFG Act) and native vegetation clearing regulations, the Plan will ensure that Victoria has a modern and effective approach to protecting and managing Victoria's biodiversity. https://www.environment.vic.gov.au/biodiversity/biodiversity-plan?mc_cid=378e6494af&mc_eid=a7fb2bf62c

Draft Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (2017)

The Department of the Environment and Energy invites interested groups and individuals to comment on this draft plan which addresses the key threatening process '*Dieback caused by the root-rot fungus Phytophthora cinnamomi*' listed under the *Environment Protection and Biodiversity Conservation Act (1999)*. It describes the research, management and other actions to reduce the impacts of Phytophthora dieback on threatened species. The public comment period will close on **24 July 2017**. http://www.environment.gov.au/biodiversity/threatened/threat-abatement-plans/draft-phytophthora-cinnamomi-2017

8th Botanic Gardens Australia and New Zealand (BGANZ) Congress – Adelaide Botanic Gardens, October 22–25, 2017

Hosted by the Botanic Gardens of South Australia. The theme for the Congress is, **'Preservation: Exploring and Adapting**'. This will cover both the natural and political environment and the required strategies to ensure the preservation of endangered species can continue by various means. The theme however also underlines the need for adaptation of Botanic Gardens themselves in the ongoing environment of their ever changing constituencies by adapting to the current needs. Themes will include Connection with community engagement, Botany, Science and Conservation, Horticulture and Horticultural Science, Internal and external education, The inspiration of the younger generations and friends and volunteers and the support of many various forms which are an integral part of Botanic Gardens. https://kaigi.eventsair.com/QuickEventWebsitePortal/bganz-congress-2017/info

NEW Plant Germplasm Conservation in Australia (E-version)

Strategies and guidelines for developing, managing and utilising ex situ collections

Australia + International orders $5.00
FREE FOR MEMBERS ONLY

For more information and to order, go to http://anpc.asn.au/publication-form

Fully revised edition 2009
Edited by C.A. Offord
and P.F. Meagher

Full of practical case studies on germplasm conservation including seed collection, banking, germination and dormancy.

Plant Germplasm
CONSERVATION
in Australia
strategies and guidelines for developing, managing and utilising ex situ collections
AUSCOR

Research Roundup

COMPILED BY KIRSTEN COWLEY
Centre for Plant Biodiversity Research. Canberra. Email: kirsten.cowley@csiro.au

Ames, G.M., Wall, W.A., Hohmann, M.G. & Wright, J.P. (2016). **Trait space of rare plants in a fire-dependent ecosystem.** *Conservation Biology* doi: 10.1111/cobi.12867

Baker, A.G. & Catterall, C. (2016). **Managing fire-dependent vegetation in Byron Shire, Australia: Are we restoring the keystone ecological process of fire?** *Ecological Management & Restoration* 17(1): 47-55. doi: 10.1111/emr.12194

Balding, M. & Williams, K.J.H. (2016). **Plant blindness and the implication for plant conservation.** *Conservation Biology* 30(6): 1192-1199. doi: 10.1111/cobi.12738

Bartel, R. & Graham, N. (2016). **Property and place attachment: a legal geographical analysis of biodiversity law reform in New South Wales.** *Geographical Research* 54(3): 267-284. doi: 10.1111/1745-5781.12151

Bennett, N.J., Roth, R., Klain, S.C., Chan, K., Christie, P., Clark, D.A., Cullman, G., Curran, D., Durbin, T.J., Epstein, G., Greenberg, A., Nelson, M.P., Sandlos, J., Stedman, R., Teel, T.L., Thomas, R., Veríssimo, D. & Wyborn, C. (2017). **Conservation social science: Understanding and integrating human dimensions to improve conservation.** *Biological Conservation* 205: 93-108. http://dx.doi.org/10.1016/j.biocon.2016.10.006

Broadhurst, L., Coates, D., Hoebee, S., Edwards, T. & Morgan, J. (2016). **Virtual Issue in Australian Journal of Botany: rare and threatened plant conversation and recovery.** *Australian Journal of Botany* 64(7&8): 659-663. http://dx.doi.org/10.1071/BTv64n8_ED2

Bustam, B.M., Dixon, K. & Bunn, E. (2016). **Ex situ germplasm preservation and plant regeneration of a threatened terrestrial orchid, Caladenia huegelii, through micropropagation and cryopreservation.** *Australian Journal of Botany* 64(7&8): 659-663. http://dx.doi.org/10.1071/BT16061

Byrne, M., Coates, D.J., Macdonald, B.M., Hankinson, M., McArthur, S.M. & van Leeuwen, S. (2016). **High nuclear genetic differentiation, but low chloroplast diversity in a rare species, Aluta quadrata (Myrtaceae), with a disjunct distribution in the Pilbara, Western Australia.** *Australian Journal of Botany* 64(7&8): 687-695. http://dx.doi.org/10.1071/BT16128

Cochrane, A., Hoyle, G.L., Yates, C.J., Neeman, T. & Nicotra, A.B. (2016). **Variation in plant functional traits across and within four species of Western Australian Banksia (Proteaceae) along a natural climate gradient.** *Austral Ecology* 41: 886-896. doi: 10.1111/aec.12381

Cook, C.N. & Sgrò, C.M. (2016). **Aligning science and policy to achieve evolutionarily enlightened conservation management.** *Conservation Biology* doi: 10.1111/cobi.12863

D'Agui, H., Fowler, W., Lim, S.L., Enright, N. & He, T. (2016). **Phenotypic variation and differentiated gene expression of Australian plants in response to declining rainfall.** *Royal Society Open Science* 3: 160637. http://dx.doi.org/10.1098/rsos.160637

Davidson, I. & O'Shannassy, P. (2017). **More than just a Long Paddock: Fostering native vegetation recovery in Riverina Travelling Stock Routes and Reserves.** *Ecological Management & Restoration* 18(1): 4-14. doi: 10.1111/emr.12247

Drielsma, M.J., Foster, E., Ellis, M., Gill, R.A., Prior, J., Kumar, L., Saremi, H. & Ferrier, S. (2016). **Assessing collaborative, privately managed biodiversity conservation derived from an offsets program: Lessons from the Southern Mallee of New South Wales, Australia.** *Land Use Policy* 59: 59-70. http://dx.doi.org/10.1016/j.landusepol.2016.08.005

Durant, R.A., Nielsen, D.L. & Ward, K.A. (2016). **Evaluation of Pseudoraphis spinescens (Poaceae) seed bank from Barmah Forest floodplain.** *Australian Journal of Botany* 64(7&8): 669-677. http://dx.doi.org/10.1071/BT15288

Foreman, P.W. (2016). **A framework for testing the influence of Aboriginal burning on grassy ecosystems in lowland, mesic south–eastern Australia.** *Australian Journal of Botany* 64(7&8): 626-642. http://dx.doi.org/10.1071/BT16081

Franklin, J., Serra-Diaz, J.M., Syphard, A.D. & Regan, H.M. (2017). **Big data for forecasting the impacts of global change on plant communities.** *Global Ecology and Biogeography* 26: 6-17. doi: 10.1111/geb.12501

Geijzendorffer, I.R., Regan, E.C., Pereira, H.M., Brotons, L., Brummitt, N., Gavish, Y., Haase, P., Martin, C.S., Mihoub, J.-B., Secades, C., Schmeller, D.S., Stoll, S., Wetzel, F.T. & Walters, M. (2016). **Bridging the gap between biodiversity data and policy reporting needs: An Essential Biodiversity Variables perspective.** *Journal of Applied Ecology* 53: 1341-1350. doi: 10.1111/1365-2664.12417

Greenfield, A., McPherson, H., Auld, T., Delaney, S., Offord, C.A., van der Merwe, M., Yap, J.-Y.S. & Rossetto, M. (2016). **Whole-chloroplast analysis as an approach for fine-tuning the preservation of a highly charismatic but critically endangered species, Wollemia nobilis (Araucariaceae).** *Australian Journal of Botany* 64(7&8): 654-658. http://dx.doi.org/10.1071/BT16105

Gellie, N.J.C., Breed, M.F., Thurgate, N., Kennedy, S.A. & Lowe, A.J. (2016). **Local maladaptation in a foundation tree species: Implications for restoration.** *Biological Conservation* 203: 226-232. http://dx.doi.org/10.1016/j.biocon.2016.08.036

Godden, L. & Cowell, S. (2016). **Conservation planning and Indigenous governance in Australia's Indigenous Protected Areas.** *Restoration Ecology* 24(5): 692-697.

Gordon, C.E., Price, O.F., Tasker, E.M. & Denham, A.J. (2017). **Acacia shrubs respond positively to high severity wildfire: Implications for conservation and fuel hazard management.** *Science of the Total Environment* 575: 858-868. http://dx.doi.org/10..1016/j.scitotenv.2016.09.129

Hewitt, J.E., Thrush, S.F. & Ellingsen, K.E. (2016). **The role of time and species identities in spatial patterns of species richness and conservation.** *Conservation Biology* 30(5): 1080-1088. doi: 10.1111/cobi.12716

Harwood, T.D., Donohue, R.J., Williams, K.J., Ferrier, S., McVicar, T.R., Newell, G. & White, M. (2016). **Habitat Condition Assessment System: a new way to assess the condition of natural habitats for terrestrial biodiversity across whole regions using remote sensing data.** *Methods in Ecology and Evolution* 7: 1050-1059. doi: 10.1111/2041-210X.12579

Hunter, J.T. (2016). **Validation of the Greater Hunter Native Vegetation Mapping as it pertains to the Upper Hunter region of New South Wales.** *Ecological Management & Restoration* 17(1): 40-46. doi: 10.1111/emr.12195

Iacona, G.D., Bode, M. & Armsworth, P.R. (2016). **Limitations of outsourcing on-the-ground biodiversity conservation.** *Conservation Biology* 30(6): 1245-1254. doi: 10.1111/cobi.12739

Jellinek, S. (2017). **Using prioritisation tools to strategically restore vegetation communities in fragmented agricultural landscapes.** *Ecological Management & Restoration* 18(1): 45-53. doi:10.1111/emr.12224

Jordan, R., Dillon, S.K., Prober, S.M., Hoffmann, A.A. (2016). **Landscape genomics reveals altered genome wide diversity within revegetated stands of Eucalyptus microcarpa (Grey Box).** *New Phytologist* 212: 992-1006. doi: 10.1111/nph.14084

Jurskis, V. (2016). **'Dieback' (chronic decline) of Eucalyptus viminalis on the Monaro is not new, unique or difficult to explain.** *Australian Forestry* 79(4): 261-264. http://dx.doi.org/10.1080/00049158.2016.1236427

Keppel, G., Robinson, T.P., Wardell-Johnson, G.W., Yates, C.J., Van Niel, K.P., Byrne, M. & Schut, A.G.T. (2017). **A low-altitude mountain range as an important refugium for two narrow endemics in the Southwest Australian Floristic Region biodiversity hotspot.** *Annals of Botany* 119: 289-300. doi: 10.1093/aob/mcw182

Kim, M.K., Evans, L., Fidelman, P., Scherl, L.M. & Marsh, H. (2017). **Structural factors influencing conservation decision-making: a case of species prioritisation in Australia.** *Journal of Environmental Planning and Management* http://dx.doi.org/10.1080/09640568.2016.1268107

Knuckey, C.G., van Etten, E.J.B. & Doherty, T.S. (2016). **Effects of long-term fire exclusion and frequent fire on plant community composition: A case study from semi-arid shrublands.** *Austral Ecology* 41: 964-975. doi: 10.1111/aec.12388

Larrosa, C., Carrasco, L.R. & Milner-Gulland, E.J. (2016). **Unintended feedbacks: Challenges and opportunities for improving conservation effectiveness.** *Conservation Letters* 9(5): 316-326. doi: 10.1111/conl.12240

Lindsay, B. (2016). **Legal instruments in private land conservation: the nature and role of conservation contracts and conservation covenants.** *Restoration Ecology* 24(5): 698-703. doi: 10.1111/rec.12399

Martin, P. (2016). **Ecological restoration of rural landscapes: stewardship, governance, and fairness.** *Restoration Ecology* 24(5): 680-685. doi: 10.1111/rec.12411

McCarthy, J.K., Mokany, K. & Dwyer, J.M. (2016). **Estimating plant abundances from crown cover and forest structure data reveals size-dependent patterns of rarity in subtropical Australia.** *Applied Vegetation Science* 19: 700-710. doi: 10.1111/avsc.12261

McCarthy, G., Moon, K. & Smith, L. (2017). **Mapping fire severity and fire extent in forest in Victoria for ecological and fuel outcomes.** *Ecological Management & Restoration* 18(1): 54-65. doi: 10.1111/emr.12242

McNamara, L. & Jones, C. (2016). **Improving investment decision-making in community-based conservation.** *Australasian Journal of Environmental Management* 23(4): 356-369. http://dx.doi.org/10.1080/14486563.2016.1214929

Murphy, H.T. & Metcalfe, D.J. (2016). **The perfect storm: Weed invasions and intense storms in tropical forests.** *Austral Ecology* 41: 864-874. doi: 10.1111/aec.12376

Neldner, V. & Ngugi, M.R. (2017). **Establishment of woody species across 26 years of revegetation on a Queensland coal mine.** *Ecological Management & Restoration* 18(1): 75-78.

Prober, S.M., Yuen, E., O'Connor, M.H. & Schultz, L. (2016). **Ngadju kala: Australian Aboriginal fire knowledge in the Great Western Woodlands.** *Austral Ecology* 41: 716-732. doi: 10.1111/aec.12377

Richardson, B.J. & Lefroy, T. (2016). **Restoration dialogues: improving the governance of ecological restoration.** *Restoration Ecology* 24(5): 668-673. doi: 10.1111/rec.12391

Shendryk, I., Broich, M. Tulbure, M.G., McGrath, A., Keith, D. & Alexandrov, S.V. (2016). **Mapping individual tree health using full-waveform airborne laser scans and imaging spectroscopy: A case study for a floodplain eucalypt forest.** *Remote Sensing of Environment* 187: 202-217. http://dx.doi.org/10.1016/j.rse.2016.10.014

Stelling, F., Allan, C. & Thwaites, R. (2017). **Nature strikes back or nature heals? Can perceptions of regrowth in a post-agricultural landscape in South-eastern Australia be used in management interventions for biodiversity outcomes?** *Landscape and Urban Planning* 158: 202-210. http://dx.doi.org/10.1016/j.landurbplan.2016.08.015

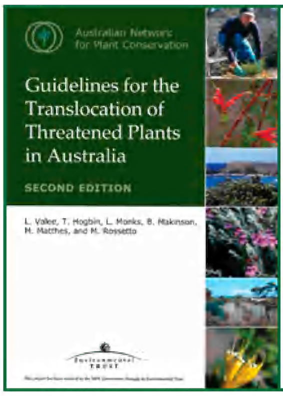
Stotz, G.C., Gianoli, E. & Cahill Jr., J.F. (2016). **Spatial pattern of invasion and the evolutionary responses of native plant species.** *Evolutionary Applications* 9: 939-951. doi: 10.1111/eva.12398

Thornhill, A.H., Mishler, B.D., Knerr, N.J., González-Orozco, C.E., Costion, C.M., Crayn, D.M., Laffan, S.W. & Miller, J.T. (2016). **Continental-scale spatial phylogenetics of Australian angiosperms provides insights into ecology, evolution and conservation.** *Journal of Biogeography* 43: 2085-2098. doi: 10.1111/jbi.12797

Villero, D., Pla, M., Camps, D., Ruiz-Olmo, J. & Brotons, L. (2017). **Integrating species distribution modelling into decision-making to inform conservation actions.** *Biodiversity Conservation* 26: 251-271. doi: 10.1007/s10531-016-1243-2

Wardell-Johnson, G., Wardell-Johnson, A., Bradby, K., Robinson, T., Bateman, P.W., Williams, K., Keesing, A., Braun, K., Beckerling, J. & Burbridge, M. (2016). **Application of a Gondwanan perspective to restore ecological integrity in the south-western Australian global biodiversity hotspot.** *Restoration Biology* 24(6): 805-815. doi: 10.1111/rec.12372

York, A. & Friend, G. (2016). **Towards an ecologically sustainable fire management strategy.** *The Victorian Naturalist* 133(5): 165-171.



Australian Network for Plant Conservation

Guidelines for the Translocation of Threatened Plants in Australia

SECOND EDITION

L. Vallee, T. Hogbin, L. Monks, B. Makinson, M. Matthes, and M. Rossetto

Guidelines for the Translocation of Threatened Plants in Australia

The deliberate transfer of plants or regenerative plant material from one place to another (eg re-introduction, introduction, re-stocking).

Second Edition 2004 | L. Vallee,T. Hogbin, L. Monks, B. Makinson, M. Matthes and M. Rossetto
Australian Network for Plant Conservation, Canberra.

For more information and to order, go to http://www.anpc.asn.au/translocation

ANPC Corporate Members

ANPC gratefully acknowledges the support of the following corporate members:

Albury Botanic Gardens, NSW

Australian National Botanic Gardens, ACT

Botanic Gardens of Adelaide, SA

Centre for Australian National Biodiversity Research, ACT

Department of Parks and Wildlife, WA

Naturelinks

Royal Botanic Gardens and Domain Trust, NSW

Royal Botanic Gardens Victoria, VIC

Royal Tasmanian Botanical Gardens, TAS

The indigenous arid shrublands around Broken Hill quickly regenerated once the reserves were destocked and fenced.

help make history

your logo here

sponsor the inaugural

Albert Morris Award and documentary

Ecological restoration practitioners, land managers and community members will gather in Broken Hill in late August 2017 to celebrate one of the world's first ecological restoration projects: the Broken Hill Regeneration Reserves, commenced in 1937 (view a short promo here).

The Albert Morris Ecological Restoration Award is poised to become a major Australian environmental award

The three-day inaugural event will attract a large amount of publicity, with bus loads of restoration practitioners coming from Australian cities to learn about this outstanding pioneering project. A festival of celebrations and educational activities is being organised by partners in Broken Hill.

Key events will be a forum and awards dinner hosted by three of Australia's leading ecological restoration organisations, Australian Association of Bush regenerators (AABR), Australian Network for Plant Conservation (ANPC), and Society for Ecological Restoration Australasia (SERA). Greening Australia (GA) is also on board as a collaborating supporter.

We have also commenced work on a short film (or series of shorts) about the regeneration reserves, their history, and what they mean to us today—we are still deciding how far to take it.

AABR

Australian Network for Plant Conservation Inc

SER AUSTRALASIA SOCIETY FOR ECOLOGICAL RESTORATION

Greening Australia

But we can't do it alone! We are calling for sponsors to help us make this a roaring success

get in touch

Albert Morris Award Committee chair info@albertmorrisaward.org
Secretary 0458 565 654

come on board

Platinum sponsor	Co-badge the awards dinner. Sponsorship will be announced at the dinner. Logo will be on all promotion and the documentary as platinum sponsor.	$3000
Gold sponsor	Sponsorship will be announced at the dinner. Logo will be on all promotion and the documentary as gold sponsor.	$2000
Silver sponsor	Logo will be on all promotion and the documentary as bronze sponsor.	$1000
Bronze sponsor	Logo will be on all promotion and the documentary as bronze sponsor.	$500

... or do yo have even grander ideas? Oh—most definately call us!
We could create a category just for you!